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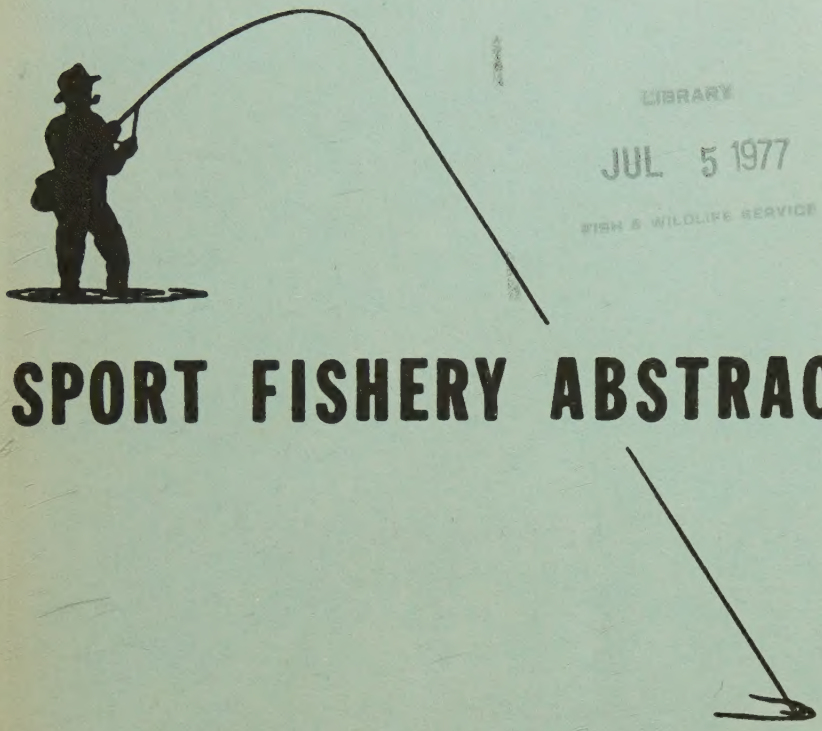

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# SPORT FISHERY ABSTRACTS

Vol. 21, No. 2, 1976

DEPARTMENT OF THE INTERIOR
U. S. FISH AND WILDLIFE SERVICE

UNITED STATES DEPARTMENT OF THE INTERIOR
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Nathaniel P. Reed, *Assistant Secretary for Fish and Wildlife and Parks*
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# SPORT FISHERY ABSTRACTS

*Roger Schoumacher, Editor*
*Terry N. Sexson, Assistant Editor*

Editorial Office
U.S. Fish and Wildlife Service
Aylesworth Hall, CSU
Fort Collins, Colorado 80523

*Sport Fishery Abstracts* is intended to furnish fishery biologists with abstracts of current literature in sport fishery research and management.

One volume, consisting of four numbers, is issued each year. Each number contains separate Author, Geographic, and Taxonomic indexes, and the final number of each volume contains cumulative Author, Geographic, Taxonomic, and Subject indexes, and a list of publications screened. Authors who publish in journals not screened for *Sport Fishery Abstracts*, and who would like their publications included, should submit abstracts to the Editor.

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# SPORT FISHERY ABSTRACTS

**An abstracting service for fishery research and management**

Volume 21 Number 2 1976

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## AQUATIC PLANTS AND THEIR CONTROL

76-000501 Berry, C. R., Jr. THE EFFECTS OF HERBICIDE TREATMENT ON A RESERVOIR ECOSYSTEM. Ph.D. dissertation, Va. Polytech. Inst. & State Univ. 227p. 1975. From Diss. Abstr. Int. B Sci. Eng. 36(12), 1976. SFA 21(2).

Nuisance populations of egeria (/Egeria densa/ Planchon) hampered the use of the 1093 ha Chickahominy Reservoir, Virginia, as a source of recreation and potable water. A mixture of diquat dibromide and potassium endothall was applied at 2.83 liters of each chemical per 0.4 surface ha. There were no measurable changes in water quality after treatment and macrophyte die-off with the exception of a general decrease in dissolved oxygen. No fish kills were observed. Both herbicides declined to very low levels in the water 3 days after treatment and were undetectable within 16 days after treatment. No endothall was found in bottom sediments. Diquat persisted in hydrosoils for one year. No herbicides were found in fish muscle tissue. Diquat and the mixture were equally effective at all concentrations tested in laboratory experiments at controlling five species of aquatic plants. Egeria repopulated the shallow areas of the reservoir one year after treatment but only repopulated the deeper areas by 42 percent by two years after treatment. /Lyngbya/ sp. increased in quantity especially in the deeper areas following treatment. No toxic effects to macroinvertebrates due to treatment were noted. Weed removal also did not affect growth of bluegill sunfish (/Lepomis macrochirus/). Tissues of bluegills collected after treatment did not histologically appear to be affected by the herbicide.

The LC(50) values for diquat and endothall separately and combined were determined for four species of fish. The toxicity of the mixture was set by the toxicity of diquat. Concentrations approximating those applied in the field (0.11 mg/liter diquat with 0.17 mg/liter endothall) did not alter bluegill respiration rate. Concentrations of the mixture as high as 11.0 mg/liter diquat and 17.0 mg/liter endothall tested over 96 g in bioassays did not cause histopathological changes in bluegill gill, kidney, or liver tissue or cause changes in hematocrit, total plasma protein electrophorograms or white blood cell differentials. Goldfish exposed to diquat and endothall separately (maximum 11.0 mg/liter diquat and 17.0 mg/liter endothall) and combined (maximum 11.0 mg/liter diquat with 17.0 mg/liter endothall) had no alternations in plasma glucose, glucocorticoids, androgens, estrogens, hematocrit, or white blood cell differential.

Anglers agreed with the use of herbicides to control aquatic weeds, and were willing to refrain from fishing while the treatment was carried out. Anglers believed that the Chickahominy weed control project increased fishing and boating enjoyment. --From abstr.

76-000502 Breen, P. A.; Mann, K. H. DESTRUCTIVE GRAZING OF KELP BY SEA URCHINS IN EASTERN CANADA. J. Fish. Res. Board Can. 33 (6): 1278-1283. June 1976. In English with French summ. SFA 21(2).

[Fish. Mar. Serv., Pacific Biol. Stn., Nanaimo, BC V9R 5K6, Canada] Destruction of kelp beds by sea urchins has been documented in St. Margaret's Bay, Nova Scotia, and also appears to be taking place in other parts of eastern Canada. Continued sea urchin settlement onto grazed areas prevents the return of kelp and other algae for long periods. Because of the large contribution of kelp beds to coastal productivity, the disappearance of kelp from large areas is alarming. Dynamics of sea urchin grazing are discussed.

76-000503 Carpenter, S. R.; Gasith, A. MECHANICAL CUTTING OF MACROPHYTES: IMMEDIATE EFFECTS ON LITTORAL WATER CHEMISTRY AND METABOLISM. Presented at the 39th Annu. Meeting, Am. Soc. Limnol. Oceanogr., Savannah, Ga., June 21-24, 1976. 1976. SFA 21(2).

[Dep. Biol., Univ. Wis., Madison 53706] Immediate consequences of mechanical cutting of submersed macrophytes may include suspension of sediments and Aufwuchs and exudation from damaged tissues which can potentially alter water chemistry and metabolism. We tested this hypothesis on two 0.2 ha plots in the density vegetated littoral of eutrophic Lake Wingra in urban Madison, WI. Initially, plots were similar in macrophyte biomass and species composition, community metabolosm (diurnal O(2) curves), and water chemistry (conductivity, BOD, and concentrations of particulate and dissolved organic C, N, and P and DRP). Plants were cut in one plot, and both plots were monitored for several days thereafter. Effects of cutting on water chemistry parameters (measured in depth-integrated samples from three points in each plot at each time) were short lived or insignificant. Phosphorus exudation was not detected /in situ/, perhaps because of rapid dissolved P turnover, although laboratory experiments indicated that $^{32}P$ release continued 48 hours after stems were severed and amounted to 5.5 to 6.5 ug P per stump. Photosynthesis and respiration were lower in the disturbed plot than in the control plot. Our results indicate that cutting of macrophytes from small areas has negligible immediate impact on water chemistry. Use of this management approach on the limited basis tested does not appear to cause substantial detriment to the littoral environment.

76-000504 Hasegawa, Y. PROGRESS OF /LAMINARIA/ CULTIVATION IN JAPAN. J. Fish. Res. Board Can. 33 (4,2): 1002-1006. Apr. 1976. In English with French summ. SFA 21(2).

[Hokkaido Reg. Fish. Res. Lab., Yoichi, Hokkaido 046, Japan] To increase the output of /Laminaria/ in Japan, considerable importance has been attached to the propagation of /Laminaria/ that grow on natural reefs. Various methods of propagation have been used, namely, planting of stones and blasting of reefs. In spite of these efforts, the productivity of /Laminaria/ of good quality has fluctuated remarkably, and further, it has been decreasing gradually. A method of cultivation was then tried. At first, however, production of /Laminaria/ of good quality did not increase readily, because this plant usually requires two winters to attain its commercial size.

As a result, the improvement of techniques for cultivating /Laminaria/ has become an important subject for research workers. During the study of the cultivative process, we have succeeded in developing techniques for rearing 2-yr-old plants in 1 yr without debasing their quality. This method is called the "Forced Cultivation Technique."

Since 1969 the yield of cultivated plants using this technique has increased remarkably in various districts from the south of Hokkaido to the northern part of the mainland of Japan.

76-000505 Neish, I. C. ROLE OF MARICULTURE IN THE CANADIAN SEAWEED INDUSTRY. J. Fish. Res. Board Can. 33 (4,2): 1007-1014. Apr. 1976. In English with French summ. SFA 21(2).

[Applied Marine Research Ltd., Halifax, NS B3J 2L4, Canada] Natural stocks of Canadian marine algae serve as sources of raw material for the alginate, carrageenan, and food seaweeds industries. The large stocks of seaweed on both coasts of Canada have stimulated investigations by workers involved in a wide range of disciplines. In recent years, the results of seaweed surveys and scientific investigations have led to the development of seaweed cultivation techniques which are assuming a commercial orientation. Commercial seaweed cultivation in Canada is in the early stages of development. Although Canadian cultivation techniques draw on Japanese cultivation techniques to some extent, the Canadian work has a number of characteristic features which stem from the economic and environmental features prevalent in the area. Canadian cultivation techniques tend to emphasize vegetative propagation in enclosures. The Canadian techniques tend to be intensive and have a low labor content. The significance of mariculture within the context of a total Canadian seaweeds industry is discussed.

76-000506 North, W. J. AQUACULTURAL TECHNIQUES FOR CREATING AND RESTORING BEDS OF GIANT KELP, /MACROCYSTIS/ SPP. J. Fish. Res. Board Can. 33 (4,2): 1015-1023. Apr. 1976. In English with French summ. SFA 21(2).

[W. M. Keck Eng. Lab., Calif. Inst. Tech., Pasadena 91109] Giant kelp (/Macrocystis/ spp.) occurs as extensive beds along the coasts of Baja California and California. The kelp beds form desirable habitat for fishes and invertebrates. The kelp plants are harvested and processed to produce food additives and chemicals. Many Californian kelp beds have dwindled or disappeared since 1940. We have developed a number of aquacultural techniques to reverse trends of deterioration. One important cause of kelp bed damage can arise from grazing by sea urchins or herbivorous fishes. Urchins can be controlled by quicklime or by crushing the animals with hammers. Fishes can be controlled by netting. In areas where kelp is sparse or has disappeared, stands can be recreated by transplantation techniques. Where reproductive processes are not adequate to maintain a stable population, mass cultures of microscopic gametophytes and sporophytes can be introduced.

76-000507 Shima, L. J.; Anderson, R. R.; Carter, V. P. THE USE OF AERIAL COLOR INFRARED PHOTOGRAPHY IN MAPPING THE VEGETATION OF A FRESHWATER MARSH. Chesapeake Sci. 17 (2): 74-85. June 1976. SFA 21(2).

[NASA/Goddard Space Flight Cent., Code 923, Greenbelt, MD 20771] Spring and fall vegetation maps were prepared from a freshwater marsh on the Patuxent River, Maryland. Low altitude, color infrared (IR) aerial photos were correlated with data obtained from field surveys. The vegetation units mapped refer to areas of homogeneous color on the photos. These areas of homogeneous color represent species associations or monospecific stands which produce a distinctive tonal signature.

Color fluctuations within an area having a distinctive tonal signature are primarily caused by quantitative variation of plant species but are also related to the growth habit, vigor of the plant species, and environmental conditions which affect the vegetation and in turn the color of the recorded image. Changes in the color over the growing season reflect plant succession, and vegetative decline.

76-000507 CONTINUED
Tonal signatures of several plant associations were due to their unique colors, saturations, and textures. Comparison of photographs made in nearby marshes demonstrated that three of the twelve spring and five of the fourteen fall vegetation units that were mapped can be reliably identified.

76-000508 Yamada, N. CURRENT STATUS AND FUTURE PROSPECTS FOR HARVESTING AND RESOURCE MANAGEMENT OF THE AGAROPHYTE IN JAPAN. J. Fish. Res. Board Can. 33 (4,2): 1024-1030. Apr. 1976. In English with French summ. SFA 21(2).
[Izu Br. Stn., Shizuoka Perfect. Fish. Exp. Stn., Japan] Agar-agar manufacturing was Japan's monopoly for about 300 yr from 1644 until about 1920, when its production was initiated in the USA by introducing techniques from Japan, and then was begun in South Korea, Indonesia, and many other countries. Today the average annual output of agar-agar of over 20 countries amounts to 6000 tons, half of which is produced in Japan.
Agarophytes are harvested in many countries and traded among them. In Japan, nearly 14,000 tons are consumed in a year, two thirds of which are imported from about 20 countries.
Under these circumstances, there is a worldwide demand for appropriate measures for resource conservation, effective harvesting, and utilization of agarophytes.
This paper presents the results of basic and applied investigations on the agarophytes and the existing state of harvesting and resource-conservation management in Japan.

GENERAL FISH CULTURE

76-000509 Bardach, J. E. AQUACULTURE REVISITED. J. Fish. Res. Board Can. 33 (4,2): 880-887. Apr. 1976. In English with French summ. SFA 21(2).
[Hawaii Inst. Mar. Biol., Kaneohe, HI 96744] Opportunities for and constraints of animal aquaculture are considered with special reference to the Pacific basin. Choice of species for husbandry depends on biological, cultural, and marketability criteria. Seed production (spawning and larval rearing) may be centralized, with certain economy of scale advantages, even in artisanal aquaculture enterprises, provided adequate distribution facilities for postlarvae are made. Larval survival rates for several actual or potential cultivars still need enhancement through applied research. Practices for the growout phase of aquatic stock differs, depending on the intensity of fixed and variable inputs, by analogy with terrestrial systems one may distinguish feedlot, managed pasturage, and ranching modes. For much of tropical Asia best expansion opportunities exist in managed pasturage polyculture possibly combining the grow-cut of crustacea for export with local, largely herbivorous and planktivorous semistaple species. Extraneously supplied feeds, when used, will differ with the species and locally available raw materials. Nonbiotechnical constraints to aquaculture expansion are found in the areas of training, credit, extension, social impact of change, and information dissemination. They may be as difficult, if not more difficult, to overcome as purely biological ones.

76-000510 Fontaine, M. HORMONES AND THE CONTROL OF REPRODUCTION IN AQUACULTURE. J. Fish. Res. Board Can. 33 (4,2): 922-939. Apr. 1976. In English with French summ. SFA 21(2).

[Mus. Nat. Hist., Inst. Oceanogr., Paris, France] The role of hormones and compounds probably intervening by hormonal mechanisms in the reproduction of teleosts are considered. First of all, the fundamental part played by the pituitary and its gonadotropic hormone or hormones in the control of reproduction are stressed by discussing problems which are still outstanding. The zoological specificity of gonadotropic hormones, the mechanism of their action, and the possibilities of using mammalian hormones are examined. The intervention of pituitary hormones other than gonadotropins is then considered. The actions of organs, tissues, and hormones secreted before the pituitary (hypothalamus, epiphysis) and that of the same formations and hormones beyond the pituitary, whose intervention is certain or under discussion (sexual steroids, hormones of the interrenal and the chromaffin tissue, ultimobranchial body and calcitonin, thyroid, urophysis) are discussed. Mention is also made of the prostaglandins.

The endocrine control of reproductive behavior and the intervention of pheromones in the reproduction of teleosts are discussed. Then the effects in reproduction of certain extrabiological substances are briefly examined (for example, clomiphene citrate, copper acetate, asphalt, petrichor, methallibure).

Final emphasis is given to the importance of ecophysiological studies in the endocrine control of reproduction, which should lead to much more natural and less costly techniques by applying data presently at our disposal, regarding hormonal control of reproductive function.

76-000511 Hirose, K. ENDOCRINE CONTROL OF OVULATION IN MEDAKA (/ORYZIAS LATIPES/) AND AYU (/PLECOGLOSSUS ALTIVELIS/). J. Fish. Res. Board Can. 33 (4,2): 989-994. Apr. 1976. In English with French summ. SFA 21(2).

[Tokai Reg. Fish. Res. Lab., Arasaki, Nagai, Yokosuka 238-03, Japan] Among gonadotropins, salmon gonadotropin gave the best response in inducing in vitro ovulation of /Oryzias/ oocytes and demonstrated a higher potency than mammalian gonadotropin. Of the steroids, cortisol was very effective in inducing in vitro ovulation of /Oryzias/ oocytes. Furthermore, ovulation cannot be induced in /Oryzias/ oocytes dissected from their follicular tissues prior to exposure to gonadotropin, suggesting that the hormone acts first on the follicular envelope to produce effective agents (corticoids?) which are then responsible for ovulation. Application of a specific inhibitor (SU-4885) of 11beta-hydroxylase resulted in inhibition of gonadotropin-induced ovulation, but did not affect ovulation induced by cortisol. The results suggest that corticosteroidogenesis in the follicular tissues is required for gonadotropin-induced ovulation. However, cortisol failed to induce in vitro ovulation of /Oryzias/ oocytes removed from their follicular tissues. Thus, ovulation may be induced by secondary agents that are produced during corticoid biosynthesis or metabolism within the follicular envelope. Water ingestion and hydration of oocytes induced by gonadotropin may be an important process at ovulation. It has also been shown that during maturation and ovulation hydration is associated with ion movement ($Na^+$). These phenomena may be related to the action of gonadotropin and/or corticoids and also occur at ovulation in the medaka. Such information may possibly yield additional clues regarding the mechanism of ovulation in fish and provide a solution to the practical problems of regulating ovulation.

76-000512 Horton, H. F.; Ott, A. G. CRYOPRESERVATION OF FISH SPERMATOZOA AND OVA. J. Fish. Res. Board Can. 33 (4,2): 995-1000. Apr. 1976. In English with French summ. SFA 21(2).

[Dep. Fish. Wildl., Oreg. State Univ., Corvallis 97331] This paper summarized historical and current attempts to cryopreserve the gametes of fish, and suggests future uses of cryogenics in fishery biology. Particular attention is given to the evaluation of procedures for collecting, freezing, thawing, and testing spermatozoa. Best methods entail manual stripping for semen, rapid freezing in the vapor of liquid nitrogen, rapid thawing of sperm cells, and fertilization tests with fresh ova. Assessment of the cryoprotective influence of common constituents of fish sperm extenders and life protectors is given. Based on current studies, a simple extender containing two salts and lecithin seems as adequate as more complex diluents. Dimethyl sulfoxide repeatedly provides best protection of salmonid spermatozoa from damage by freezing. Considering current developments, recommendations are made for improving cryoprotective procedures. The paper concludes with speculation on cryo-preserving eggs, and on possible areas for further research.

76-000513 Jalabert, B. IN VITRO OOCYTE MATURATION AND OVULATION IN RAINBOW TROUT (/SALMO GAIRDNERI/), NORTHERN PIKE (ESOX LUCIUS/), AND GOLDFISH (/CARASSIUS AURATUS/). J. Fish. Res. Board Can. 33 (4,2): 974-988. Apr. 1976. In English with French summ. SFA 21(2).

[Inst. Natl. Rech. Agron., 78350 Jouy-en-Josas, France] The endocrine processes which control oocyte maturation of meiosis and ovulation have been studied in vitro in the trout /Salmo gairdneri/. Follicular maturation is ultimately under the control of a pituitary gonadotropin which induces the follicle to synthesize specific steroids; these steroids act in turn directly on the oocyte to promote maturation. The systematic study of the in vitro efficiency of various steroids have shown that 17alpha-hydroxy-20beta-dihydroprogesterone plays a preferential role in initiating maturation; this steroid has a high affinity for a plasma protein system. The efficiency of this steroid, similarly to the efficiency of the gonadotropin, can be modulated by other circulating steroids. The precise chronology of some events of follicle maturation have been defined using inhibitors of protein and RNA synthesis.

The ovulatory process (sensu stricto: expulsion of matured oocyte from the follicular envelopes) has been experimentally dissociated from oocyte maturation, and some mediators likely to act on ovulation have been identified.

These data permit the consideration of novel means of intervention at the ovarian level to synchronize maturation and ovulation in fish, in order to give new tools for progress in aquaculture.

76-000514 Jenio, F.; See, C. COMPARISON OF BENTHIC INVERTEBRATES ABOVE AND BELOW A TROUT HATCHERY DISCHARGE. Proc. W. Va. Acad. Sci. 48 (1): 21. 1976. Abstract only. SFA 21(2).

[Div. Sci. Math., Glenville State Coll., Glenville, WV 26351]

76-000515 Milne, P. H. ENGINEERING AND THE ECONOMICS OF AQUACULTURE. J. Fish. Res. Board Can. 33 (4,2): 888-898. Apr. 1976. In English with French summ. SFA 21(2).

[Dep. Civ. Eng., Univ. Strathclyde, Glascow, Scotland]. The engineering developments of the last decade into the design and construction of facilities for aquaculture have considerably improved the economic prospects.

This review of engineering techniques for aquaculture discusses the problems of site selection and analysis with special reference to the requirement of pollution-free water and its abstraction rate. The design and construction of facilities used for aquaculture are described for land-based farms, sea enclosures, and cages. The various types of ponds and tanks and their advantages of adaptability are emphasized. Examples are given of sea enclosures, both intertidal and sublittoral, the latter being either rigid or flexible frameworks. The diversification throughout the world of materials and techniques for fish cage construction, using rigid and flexible frameworks, are considered with their advantages and disadvantages.

The need for careful monitoring of the surrounding environment in marine aquaculture is most important since the sea enclosures or cages may affect the hydrography of the area, and marine fouling will alter the water currents.

It is felt that the most important future developments in aquaculture are first the utilization of the present underexploited resource of heated waste water from power station outfalls, and secondly the ability to produce really reliable filtration units for commercial closed cycle circulation systems.

The advances made in the last decade indicate hopeful signs that the FAO projected requirement of 40 million tons of fish and shellfish will be met from aquaculture by the year 2000.

76-000516 Pritchard, G. I. STRUCTURED AQUACULTURE DEVELOPMENT WITH A CANADIAN PERSPECTIVE. J. Fish. Res. Board Can. 33 (4,1): 855-870. Apr. 1976. In English with French summ. SFA 21(2).

[Fish. Mar. Serv., Resour. Serv. Dir., Ottawa, ON K1A 0H3, Canada] Wild fisheries resources in Canada will be increasingly replaced or augmented by aquaculture as they diminish or encounter difficulty in satisfying market demands. Commercial forms of aquaculture still suffer from the lack of innovative policies, well-delineated strategies, and pilot-scale experimentation in operational planning. The aquaculture activities in Canada are reviewed and analyzed in this paper against a model for technological planning and social futures, and against developments elsewhere in food systems. It concludes that substantial research and experimental development effort are still needed, and that the lead time for undertaking these activities is short if risk captial is not to be jeopardized. High priorities are given in support of i) innovative policy development (resource inventories, public anticipations, etc.), ii) strategic forecasting and planning (business strategies, modular enterprise structures, marketing, disease control, a gene pool of aquatic stocks, sea-ranching, aquatic polycultures, introduction of nonidigenous species, waste utilization, etc.), and iii) commercial operations (feed formulation, brood stock selection, water reconditioning, product development, production tactics, pollution control, etc.). There is a shortage of skilled aquaculture practitioners, and a need for more highly trained scientific personnel to address themselves explicitly to aquaculture. In Canada, this industry has already begun to take on an innovative structure that makes it a model for other forms of fisheries development.

76-000517 Sribhibhadh, A. ROLE OF AQUACULTURE IN ECONOMIC DEVELOPMENT WITHIN SOUTHEAST ASIA. J. Fish. Res. Board Can. 33 (4,2): 899: Apr. 1976. In English with French summ. Abstract only. SFA 21(2).

[Southeast Asian Fish. Div. Cent., Samutprakarn, Thailand] The potential for aquacultural development in Southeast Asia, especially in its extensive coastal areas, is one of great significance in the world's food production. The region not only has long established traditions in fish culture but also has culturable indigenous species suitable for commercial production as well as general climatic conditions and other natural amenities favorable and conducive to aquacultural practices.

In most Southeast Asian countries, although overall economical and agricultural development are critically interdependent, fisheries, in general, are not a major sector of their national economics. Nonetheless, aquaculture is economically, culturally, and nutritionally important to these countries. Social and economic impacts of increased fish supplies in nutrition of the population, more employment opportunities, greater foreign exchange earnings through export, and other multiplier effects resulting from aquacultural development do play important catalytic, as well as direct, contributing roles in the national economic development.

76-000518 Yamazaki, F. APPLICATION OF HORMONES IN FISH CULTURE. J. Fish. Res. Board Can. 33 (4,2): 948-958. Apr. 1976. In English with French summ. SFA 21(2).

[Fac. Fish., Hokkaido Univ., Hakodate, Japan] Methyltestosterone, when incorporated in the diet at a concentration of 1 ppm, accelerated the growth of goldfish (/Carassius auratus/), horai masu, a variant of rainbow trout (/Salmo gairdneri/), and kokanee (/Oncorhynchus nerka/). Simultaneous acceleration in the growth of the testes was also observed in some of the horai masu. Administration of 5 ppm methyltestosterone or diethylstibestrol in the diet combined with injection of salmon gonadotropin was effective in accelerating the sexual maturation of rainbow trout. However, a concentration of 50 ppm methyltestosterone inhibited gonadal development is the treatment was initiated shortly after hatching and continued for a period of 5 mo. The fish thus treated were found to have threadlike gonads even after 3 yr. Courtship behavior and feeding behavior were also influenced by methyltestosterone treatment. The sex ratio of zebra fish (/Zebra fario/) and rainbow trout was altered when the administration of methyltestosterone was initiated just after hatching. This suggests a strong possibility of introducing sex reversal or mono sex culture in these important commercially raised fish. Results with the cobalt variant of rainbow trout, a fish lacking a complete pituitary and found only with immature gonads, suggest that this animal may be a promising model for future studies in fish endocrinology.

## TROUT AND SALMON CULTURE

76-000519 Ayles, G. B.; Lark, J. G. I.; Barica, J.; Kling, H. SEASONAL MORTALITY OF RAINBOW TROUT (/SALMO GAIRDNERI/) PLANTED IN SMALL EUTROPHIC LAKES OF CENTRAL CANADA. J. Fish. Res. Board Can. 33 (4,1): 647-655. Apr. 1976. In English with French Summ. SFA 21(2).

[Fish. Mar. Serv., Freshwater Inst., Winnipeg, MB R3T 2N6, Canada] The seasonal mortality pattern and the causes of the mortality of planted rainbow trout (/Salmo gairdneri/) were studied in eight small eutrophic lakes in central Canada used for extensive aquaculture. Two periods of mortality were revealed. The first occurred in all lakes

76-000519 CONTINUED
during the first 60 days of residence in the lakes and resulted in the mortality of 60-90 percent of the numbers of fish stocked. The second period occurred in about 20 percent of the lakes and was due to low oxygen levels following the collapse of a bloom of /Aphanizomenon flos-aquae/. Rainbow trout are close to their physiological upper tolerance levels in these lakes. Possible environmental and biological causes of mortality during the first period are discussed.

76-000520 Babushkin, Yu. P. A COMPARATIVE MORPHOLOGICAL DESCRIPTION OF MALE RAINBOW TROUT [/SALMO IRIDEUS/] FROM DIFFERENT GROUPS. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (5): 717-726. 1974. SFA 21(2).

[GosNIORKh, Leningrad, USSR] A study has been made of the morphology of males of two groups of rainbow trout (/Salmo irideus/) at different ages between underyearlings and 5 years. It is shown that age and the mass selection that is carried out play a considerable role in levelling out the differences in morphological characters between males of the groups compared. Before mass selection there are significant differences in underyearlings in most morphological characters. After mass selection the differences between the groups are abruptly reduced in yearlings and completely levelled out when the males reach an age of 4+. Correlations are established between certain morphological characters and these correlations are shown to alter with the age of the males.

76-000521 Gjedrem, T. POSSIBILITIES FOR GENETIC IMPROVEMENTS IN SALMONIDS. J. Fish. Res. Board Can. 33 (4,2): 1094-1099. Apr. 1976. In English with French summ. SFA 21(2).

[Dep. Anim. Genet. Breeding, Agric. Univ. Norway, As-NLH, Norway] No systematic breeding work has been done so far with salmonids except for some attempts with rainbow trout (/Salmo gairdneri/) and Pacific salmon.

The possibilities for obtaining genetic change are particularly dependent on selection intensity, heritability, phenotypic variance, and length of generation interval. The very high fertility in salmonids makes it possible to practice an intensive selection for fish in captivity and a more moderate selection in wildlife cultivation. Very few estimates of heritability have been calculated for production traits in salmonids and most of them are based on limited data. The few estimates for growth rate are moderately large ($/h/^2$ = 0.1-0.2). For most production traits studied, a remarkably high phenotypic variance has been found, and the coefficient of variation is 2-4 times as high as for production traits in farm animals. The length of generation interval varies from one species to another and with the production system applied; 2-5 yr will be the usual.

To make a selection program possible, one must control the whole life cycle of the fish. Therefore, hatching, fingerling production, and cheap and efficient tagging methods are necessary requirements.

Because of the high fertility, the large variation and a moderately long generation interval, it should be possible to obtain much higher genetic gain per time unit in salmonids than in farm animals.

76-000522 Joyner, T. FARMING OCEAN RANGES FOR SALMON. J. Fish. Res. Board Can. 33 (4,2): 902-904. Apr. 1976. In English with French summ. SFA 21(2).

[Int. Cent. Living Aquatic Resour. Manage., Honolulu, HI 96812] Recent advances in the culture of salmon point the way to a significant expansion of the scale on which the resource can be effectively managed. From the purely local efforts focused primarily on mitigation of the losses of spawning areas that have characterized traditional salmon culture, we can now progress to the manipulation of stocks on a worldwide scale. International cooperation in the management of salmon as a basic range crop for subpolar seas could provide the seed for the development of a truly international system of planetary aquaculture in which oceans and seas will be managed as a range and farmland.

## WARMWATER CULTURE

76-000523 Chaudhuri, H. USE OF HORMONES IN INDUCED SPAWNING OF CARPS. J. Fish. Res. Board Can. 33 (4,2): 940-947. Apr. 1976. In English with French summ. SFA 21(2).

[Cent. Inland Fish. Res. Substn., Cuttack, India] The role of hormones in regulating the ovulation and spawning in fishes is still controversial and inconclusive. Although remarkable progress has been made during the last decade in studying the effect of various hormones on the reproductive physiology of a number of fishes, little information is available on the regulation of hormones in the spawning of the difficult-to-spawn carps, namely the major Indian and Chinese carps. These important cultivated species, although they attain maturity in ponds, fail to reproduce in that environment in the absence of external stimuli which are essential for the release of gonadotropins resulting in ovulation and spawning.

Attempts made to breed these carps by injections of mammalian hormone preparations did not meet with much success. Administration of fish pituitary hormones, on the other hand, induced ovulation and successful spawning in these fishes. While extensive use of crude pituitary treatment for production of carp seed is in vogue in pisciculture all over the world, attempts are being made to replace it by purified gonadotropins from piscine pituitary glands. Recent work on the purification of salmon and carp gonadotropin marks the beginning towards achievement of success in the field.

This paper describes the techniques of hormone administration in major Indian and Chinese carps and discusses the effects of various hormones on their spawning. It also reviews the progress made in the study of the reproductive physiology of some closely related species.

76-000524 Gun'ko, A. F. THE BIOLOGICAL BACKGROUND OF A NEW ASPECT OF THE BASIC OUTLINE OF THE HATCHERY REARING OF STURGEONS (HRS). J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (6): 986-989. 1974. SFA 21(2).

[Azov Fish. Res. Inst., Azov, USSR]

76-000525 Igumnova, L. V. THE TIME TAKEN FOR BELUGA (/HUSO HUSO/) FEMALES TO MATURE AT DIFFERENT TEMPERATURES FOLLOWING A PITUITARY INJECTION. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (6): 890-895. 1974. SFA 21(2).

[Volgagrad Sturgeon Hatchery, Volgagrad, USSR] The article sets out data for a number of years on the time taken by Volga beluga females to mature when they congregate in the after bay of the Volga power station. The relative characteristic of maturation time is used to forecast maturation time following a pituitary injection in a wide range of temperatures. The possibility of such forecasting enables us to reduce the losses of eggs arising from the opening of immature or over-mature females and facilitates work with spawners.

76-000526 Jhingran, V. G. SYSTEMS OF POLYCULTURE OF FISHES IN THE INLAND WATERS OF INDIA. J. Fish. Res. Board Can. 33 (4,2): 905-910. Apr. 1976. In English with French summ. SFA 21(2).

[Cent. Inland Fish. Res. Inst., Barrackpore, West Bengal, India] Different systems of polyculture of fishes are traditionally practiced in India to utilize various types of inland water resources available in the country. The usually cultivated species of fish in freshwater polyculture are /Catla catla/, /Labeo rohita/, and /Cirrhinus mrigala/. Culture of Chinese carps along with major Indian carps has recently been developed in India as composite fish culture, and with this, production as high as 3000-5800 kg/ha per 6 mo and 7000-9000 kg/ha per yr has been obtained in still-water ponds in different parts of the country. The magnitude of production is significant considering its application to the large resource of ponds and tanks totaling about 1.6 million ha, though only 1 million ha are presently available for carp culture. The remaining 0.6 million ha comprise swamps and derelict waters. The cost of swamp reclamation being high, techniques of mixed culture of air-breathing fishes are being developed to utilize these water bodies as such and already a production of 895 kg/ha per yr of murrels has been attained without any fertilization and supplementary feeding. Further, to utilize about 2.0 million ha of culturable brackish waters available in India, research investigations are well underway to manipulate the tidal impoundments for mixed culture of brackish water fish and prawns with proper scientific management.

76-000527 Rudenko, G. P.; Volokhonskiy, A. G.; Tarasova, S. G.; Tereshenkov, I. I. INTENSIFICATION OF FISH CULTURE AND ITS EFFECT ON THE ECOLOGY OF SMALL LAKES. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (3): 326-335. 1974. SFA 21(2).

[GosNIORKh, Lenningrad, USSR] Fish were intensively reared for 3 years (every summer) in an eutrophic lake using mineral fertilizers and artificial foods. An analysis is made of the changes in the food resources and the chemical hydrologic regime under the influence of the intensification measures carried out, which had a direct or indirect effect on the ecological situation in the lake. Consideration is given to aspects of the cultivation of fish for sale and to food interrelationships and recommendations are made on the use of fertilizers and the stocking densities of pond carp and pelyad for single year feeding.

76-000528 Statova, M. P. THE STATE OF THE ANTERIOR PITUITARY IN PHYTOPHAGOUS FISHES BEFORE AND AFTER PITUITARY INJECTIONS. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (2): 240-248. 1974. SFA 21(2).

[Inst. Zool., Moldavian Acad. Sci., Kishinev, USSR] Investigations were made of the pituitaries and gonads of grass carp [/Ctenopharyngodon idella/] and bighead carp [/Hypophthalmichthys molitrix/] females selected for artificial reproduction in the incubator section of the Kuchurgan Fishery Cooperative (Moldavia) in the course of May-June 1968 and 1970. Data are given on the alteration in the morpho-physiological state of the basophilic cells of the mesoadenohypophysis and the gametes during the period for which females are retained in the ponds and at various intervals after pituitary injections.

76-000529 Sundararaj, B. I.; Vasal, S. PHOTOPERIOD AND TEMPERATURE CONTROL IN THE REGULATION OF REPRODUCTION IN THE FEMALE CATFISH /HETEROPNEUSTES FOSSILIS/. J. Fish. Res. Board Can. 33 (4,2): 959-973. Apr. 1976. In English with French summ. SFA 21(2).

[Dep. Zool., Univ. Delhi, Delhi 110007, India] The annual reproductive cycle of the catfish /Heteropneustes fossilis/ is divided into the preparatory period (February-April), prespawning period (May-June), spawning period (July-August), and postspawning period (September-January). Ovarian recrudescence, which normally occurs during the prespawning period, can be advanced by photothermal manipulations. During the postspawning and preparatory periods, the tempo of ovarian recrudescence is much faster at 30 C than at other temperatures (ambient, 25 or 34 C) regardless of photoperiod (14L + 10D, 12L + 12D, or 9L + 15D).

Warm temperature (30 C) postpones the postspawning ovarian regression only up to the first week of October regardless of photoperiod. The ovarian cycle is regulated by a circannual rhythm which can be activated 5 mo earlier, but its activity cannot be prolonged beyond October by photoperiodic and temperature manipulations.

Interruption of the night of a short day (6L + 18D) treatment by 1 h of light between 0000 and 0100 induces ovarian recrudescence that is significantly greater than that obtained in the control group exposed to 7L + 17D. Scanning of the major part of the dark period (1800-0500) to determine the duration of the photo-inducible phase shows that it lies between 0000 and 0500 with peaks from 0000 to 0100 and from 0400 to 0500. Even 1 h of light in a regimen of 1L + 23D presented between 1900 and 0500 produces significant ovarian recrudescence with peaks between 2200 and 0100. These results clearly demonstrate the possible involvement of a circadian mechanism for photoperiod measurement in the catfish.

Precociously gravid catfish obtained as early as April by photothermal treatment have been induced to spawn in the laboratory by administration of ovine luteinizing hormone (LH). Ripe eggs after fertilization hatched into seemingly normal fry. Further, the spent fish when subjected to the same photothermal treatment developed a fresh crop of yolky eggs within 1 mo; such gravid females have been again induced to spawn with LH. This process has been repeated so that the same set of fish have been spawned 4 times between April and July of the same year. Thus, it is possible to get catfish fry not only early but also 2.6 times more than that usually available from each female during the spawning season. The aquacultural potentialities of this laboratory discovery are discussed.

MARICULTURE

76-000530 Calaprice, J. R. MARICULTURE--ECOLOGICAL AND GENETIC ASPECTS OF PRODUCTION. J. Fish. Res. Board Can. 33 (4,2): 1068-1087. Apr. 1976. In English with French summ. SFA 21(2).

[Dep. Biol. Sci., Univ. Calif., Santa Barbara 93106] The culture of marine organisms may be classified into four categories. /Marine animal husbandry/: the intensive culture in floating pens or impoundments of salmonids in Europe and North America and yellowtail (/Seriola quinqueradiata/), puffer, and shrimp (/Penaeus japonicus/) in Japan yields 3,000-610,000 kg/ha per yr. /Traditional mariculture/: the culture of milkfish, mullet and shrimp in ponds and ground culture of oysters and mussels yields 200-5,000 kg/ha per yr. /Float culture of sessiles/ such as oysters, mussels, and algae yields 80,000-750,000 kg/ha per yr. /Sea ranching/: the culture of salmonids in hatcheries, release prior to migration and subsequent recapture. Coho (/Oncorhynchus kisutch/), chinook (/O. tshawytscha/), and Atlantic salmon (/Salmo salar/) yield 0.76-2.5 million kg/ha per yr while pink (/O. gorbuscha/) and chum salmon (/O. keta/) yield 2.3-22.0 million kg/ha per yr. Data on nutritional and ecological requirements are discussed in relation to the feasibility of increasing yields using genetic methods.

76-000531 Chen, T. P. CULTURE OF MILKFISH (/CHANOS CHANOS/) AS A MEANS OF INCREASING ANIMAL PROTEIN SUPPLY. J. Fish. Res. Board Can. 33 (4,2): 917-919. Apr. 1976. In English with French summ. SFA 21(2).

[Taiwan Fish. Consultants, Inc., Taipei, Taiwan] Among the marine fishes, the milkfish (/Chanos chanos/) is most successfully cultured in ponds. The total area of milkfish ponds in the three main milkfish producing countries (Indonesia, Philippines, and Taiwan) is about 320,000 ha. Yield of about 2000 kg/ha per yr is being achieved in Taiwan, the yield in Indonesia (340 kg/ha per yr) and Philippines (560 kg/ha per yr) being considerably lower.

If the pond management method of Taiwan is adopted, the present 320,000 ha of milkfish ponds of the above mentioned three countries could produce at least 640,000 metric tons of milkfish per year. Production could be further increased by increasing the fish pond acreage. (Philippines has some 400,000 ha of undeveloped mangrove covered swampland that could be developed into fish ponds).

Increase of milkfish production by expansion of the cultural areas faces the following problems: 1) limitation of the natural supply of seed fish; 2) market demand; and 3) effects of milkfish farming on local ecology.

Little research on milkfish has been done. It is proposed that future research should emphasize: 1) research on artificial propagation of milkfish to supply seed for milkfish farming; 2) research on the nutritional requirements and feeding habits of milkfish; 3) research on modification of present cultural practice to permit polyculture in milkfish ponds; and 4) research on processing milkfish into products of universal acceptance.

76-000532 Fujiya, M. YELLOWTAIL (/SERIOLA QUINQUERADIATA/) FARMING IN JAPAN. J. Fish. Res. Board Can. 33 (4,2): 911-915. Apr. 1976. In English with French summ. SFA 21(2).

[Freshwater Fish. Res. Lab., Hino-shi, Tokyo, Japan] Yellowtail, /Seriola quinqueradiata/, culture has developed successfully on a commercial scale in Japan. Because of its suitability for aquaculture, it has become the most important species in marine fish farming.

Artificial seed production technique has been advanced experimentally, and the artificially produced seed will supersede the natural source in the near future.

The fish are cultured mostly in floating net cages in the shallow coastal regions, and in recent years the submerged cage culture technique has contributed to the expansion of production. At present, yellowtail growers, mostly family groups, can find a ready market for their product, and can realize middle-class incomes. On the other hand, consumers are able to obtain a stable supply of this staple food.

In spite of the well-developed situation, there are still some problems. Diseases and the shortage of feeds are serious constraints for future progress. The development of suitable disease control techniques and new effective feeds will furnish a key for the solution of these problems.

The techniques of intensive marine fish culture developed with yellowtail will be a valuable example for the development of marine farming in the future.

76-000533 Purdom, C. E. GENETIC TECHNIQUES IN FLATFISH CULTURE. J. Fish. Res. Board Can. 33 (4,2): 1088-1093. Apr. 1976. In English with French summ. SFA 21(2).

[Minist. Agric., Fish. Food, Fish. Lab., Lowestoft, Suffolk, England] Selection for improved growth rate does not appear to be feasible in flatfish because the environmental component of variation is very large. Selection for other characters has not been studied. The development of inbred lines, and their use in F1 hybrid production, seems warranted in fish farming if only as a means of avoiding inbreeding depression of fitness. Gyncgenesis may be a practical means for accelerating the rate of inbreeding in fish. Induced triploidy is a potentially useful technique in fish culture in that it prevents sexual maturation and limits the depression of growth associated with this. Hybridization is a common phenomenon among fish and can lead to a form of hybrid vigor. Its application in fish culture may be limited by marketing problems where fish are sold under a specific name.

## FEEDS, FEEDING AND NUTRITION

76-000534 Cowey, C. B. USE OF SYNTHETIC DIETS AND BIOCHEMICAL CRITERIA IN THE ASSESSMENT OF NUTRIENT REQUIREMENTS OF FISH. J. Fish. Res. Board Can. 33 (4,2): 1040-1045. Apr. 1976. In English with French summ. SFA 21(2).

[N.E.R.C Inst. Mar. Biochem., Aberdeen, AB1 3BA, United Kingdom] Dietary allowances of nutrients have been formulated mainly from growth-response curves. The use of other criteria, especially those which exploit the biochemical role of nutrients, is discussed by reference to three different nutrients, namely thiamin, magnesium, and essential fatty acids.

It is shown that erythrocyte transketolase activity provides a nutritional index of thiamin status in turbot (/Scophthalmus maximus/).

The enzyme is saturated with coenzyme (thiamin pyrophosphate) at a

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dietary thiamin level of 2.6 mg/kg.

Assessment of mineral requirements is shown tc present special problems because complex interrelationships exist between some dietary minerals. It is shown that dietary magnesium deficiency (1 mg magnesium/100 g diet) leads to renal calcification in rainbow trout (/Salmo gairdneri/) at dietary calcium levels cf 2.7 g/100 g (Ca:P ration 1:1). Elevation of dietary magnesium to 100 mg/100 g under these conditions gave freedom from pathology and enhanced growth.

Ratios of certain fatty acids in the tissue phospholipids of rainbow trout are known to provide a useful index of essential fatty acid status. These ratios cannot be applied to turbot as this species does not chain elongate and desaturate 18-carbon acids at appreciable rates. Long chain polyunsaturated fatty acids of the omega 3 series must be supplied preformed in the diet of turbct.

76-000535 Cruz, E. M. DETERMINATION OF NUTRIENT DIGESTIBITILY IN VARIOUS CLASSES OF NATURAL AND PURIFIED FEED MATERIALS FOR CHANNEL CATFISH. Ph.D. dissertation, Auburn Univ. 94p. 1975. From Diss. Abstr. Int. B Sci. Eng. 36(11), 1976. SFA 21(2).

The digestibitily of nutrients in several classes of natural feedstuffs and in purified sources by channel catfish /Ictalurus punctatus/ (Rafinesque), was determined by the indirect indicator method using chromic sesquioxide (1 percent) as the indicator substance. Apparent protein digestibility ranged from 74.0 to 89.9 percent in animal by-products, 76.6 to 83.6 percent in oil seed meals, and 59.5 to 83.8 percent in cereals and by-products, and was 12.5 percent for alfalfa meal. Gross energy digestibility ranged from 66.6 to 85.4 percent in animal by-products, 53.3 to 59.0 percent in oil seed meals, 26.1 to 60.4 percent in cereals and by-products, and 14.3 to 17.0 percent in alfalfa meal. Digestibility of glucose was above 90 percent but digestibitily of dextrin, and cooked and raw corn starch was appreciably lower. Except for the raw corn starch diet, the digestibility of protein and lipids decreased as the level of carbohydrates in the diets increased from 30 to 60 percent. The digestibility of lipids ranged from 76.0 to 97.8 percent, except in alfalfa meal which was 50.5 percent. The fish digested 1.93 to 32.1 percent of purified alpha cellulose and 2.8 to 29.3 percent of natural cellulose in the plant feedstuffs. Metabolic fecal nitrogen excreted by fish fed a nitrogen-free diet averaged 310 mg per 100 g dry diet or 185 mg per 100 g dry feces. True protein digestibility of feedstuffs was higher than the apparent protein digestibility. The difference was greater for the diets that were less digestible. --From abstr.

76-000536 Halver, J. E. FORMULATING PRACTICAL DIETS FOR FISH. J. Fish. Res. Board Can. 33 (4,2): 1032-1039. Apr. 1976. In English with French summ. SFA 21(2).

[U.S. FWS, Coll. Fish., Univ. Wash., Seattle 98195] Formulas for balanced fish diets must include an energy source plus sufficient indispensable amino acids, essential fatty acids, and specific vitamins and minerals to support life and to promote adequate growth. Tentative requirements for the 10 indispensable amino acids and evaluation of the sparing effect of several others have been reported for only a few species of fish held under specific experimental conditions. These findings must be confirmed for other species and other rearing conditions, since the protein requirement and amino acid balance is the major determinant for growth, and is the greatest food source problem. Essential fatty acid needs for fish reared indicate that this component may be the second limiting factor for future practical diets. Water-soluble and fat-soluble vitamin needs have been reported for only a few fish and these data must be extended to include other species and fish reared in different waters. Digestion

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coefficients of diet ingredients, measured for terrestrial animals, must be confirmed in fish before data banks of nutrient ingredient sources can be translated into least-cost computer diet formulas. Specific nutrient requirements vary with species, size, water temperature, stress, and nutrient balance; thus, economical rations must be programmed accordingly. Techniques that have been developed for determining metabolizable energy and digestibility of diet components for several species can be expanded to develop diets and rations for scientific fish husbandry.

76-000537 Huh, H. T. BIOENERGETICS OF FOOD CONVERSION AND GROWTH OF YELLOW PERCH (/PERCA FLAVESCENS/) AND WALLEYE (/STIZOSTEDION VITREUM VITREUM/) USING FORMULATED DIETS. Ph.D. dissertation, Univ. Wis. (Madison) 213p. 1975. From Diss. Abstr. Int. B Sci. Eng. 36(11), 1976. SFA 21(2).

With a brief training period of feeding the formulated diets, these fish could be raised in the laboratory with controlled temperature and photoperiod. The effects of temperature and photoperiod on growth were similar in both fish with maximum growth occurring at 22C ± 1 and 16 hours of photoperiod, when fed the 3 percent daily ration of the wet body weight. The temperature ranges for favorable growth seemed to be at 20-24C for the perch and 19-27C for the walleye. The ration level at 3 percent of wet body weight appeared most realistic level to be fed for optimal growth of the perch and walleye. The more frequent feedings per day for a given ration yielded better growth. It was suggested that the perch (or walleye) of 15 g or smaller fingerlings should be fed four or more times per day. There were no statistically significant differences between the growth of fish fed the 50, 40, and 27 percent protein diets after about ten weeks of rearing in the tanks. The yellow perch seemed to be a more efficient food converter than the walleye. Total energy balances (output energy/input energy x 100) found were 105 percent for the perch and 79 percent for the walleye. Specific growth rates during the 296 days study period averaged approximately 1.0 percent of weight per day in the walleye and 1.4 percent for the perch. The length-weight relationship showed that the weight exponent, n (growth power) of the laboratory-grown yellow perch was greater than the cube of the length (3.2) until fish reached to 180 mm in length and then declined to below the 3.0 level. Total mean value of the coefficient of condition (K) was 1.8. --From abstr.

76-000538 Konstantinov, A. S. WAYS OF DETERMINING THE FEEDING RATE OF STEADILY CONSUMING FISHES. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (4): 566-571. 1974. SFA 21(2).

[Dep. Ichthyol., Moscow Univ., Moscow, USSR] The meaning of the concept "feeding rate" is clarified. A critical examination is made of the formula used at present to calculate the feeding rate of steadily consuming fishes from the indices of fullness of the intestines. Corrected formulas are proposed for the determination of daily rations based on allowance for the extent of absorption of the digested food as it passes through the intestines.

76-000539 Mironova, N. V. THE ENERGY BALANCE OF /TILAPIA MOSSAMBICA/. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (3): 431-438. 1974. SFA 21(2).

[Zool. Inst., USSR Acad. Sci., Leningrad, USSR] The energy balance of /Tilapia mossambica/ reared on different types of food has been calculated over the first 6 months of life. It is established that the assimilation of all foods by young individuals is low and increases with age, that the amount of food assimilated in 24 hours and the relative mean daily growth increment are the same for all variants of the ration and that the indices of the utilization of assimilated food for growth are high. The slightly greater daily increments in fish fed on animal and mixed food lead to differences in the average weight of individuals of the same age fed on different food. Consideration is given to age-related changes in food consumption, in the assimilability of the food and in growth, to expenditure on metabolism and to the coefficients of the utilization of food for growth in /T. mossambica/ up to an age of 6 months.

76-000540 Weatherley, A. H. FACTORS AFFECTING MAXIMIZATION OF FISH GROWTH. J. Fish. Res. Board Can. 33 (4,2): 1046-1058. Apr. 1976. In English with French summ. SFA 21(2).

[Inst. Biol. Geol., Univ. Tromso, N-9001 Tromso, Norway] Studies of fish growth bioenergitics include investigations of variables such as Standard Metabolic Rate (SMR), Specific Dyanmic Action (SDA), and activity. There is now an increasingly sophisticated attempt to measure these and other components of bioenergetics, such as foraging and other forms of activity, and relate growth to them in mathematical expressions. Such expressions can be very valuable in identifying the parameters that remain to be determined in the field or experimentally for a full and formal accounting of growth energetics. Energy compartmentilization studies can form the factural basis in a superior management of cultured fish populations for growth (and production) maximization and can offer a necessary framework for the genetical improvement of growth which has been lacking hitherto.

Knowledge of fat and protein dynamics can permit optimization of production of useful materials by fish if that is considered an advantage over the usual attempts to maximize growth and production of fish as caloric units.

Cell biology, determination of optimal vitamin levels, and the mechanisms of hormonal control of growth may offer additional research problems leading to growth maximization.

The structure of fish growth curves should be studied because they can reveal differences about the assimilative capabilities of fish not only between species, but also between life stages or in different environments.

The study of growth is a multidisciplinary program, demanding inputs of information from a number of fields, which bears the promise of a perhaps dramatic improvement in production of fish from aquaculture.

## AQUARIUMS

76-000541 Watters, K. W.; Prinslow, T. E. AN EMERGENCY WATER SUPPLY FOR SMALL AQUARIUM SYSTEMS. Trans. Am. Fish. Soc. 105 (2): 347-348. Mar. 1976. SFA 21(2).

[Puerto Rico Nuclear Cent., College Station, Mayaguez 00708] An emergency standby pumping system for small aquariums is described, which is independent of the main aquarium pumping system, has a self-contained power supply, and starts and resets automatically.

MISCELLANEOUS CULTURE TECHNIQUES AND EQUIPMENT

76-000542 Huguenin, J. E. HEAT EXCHANGERS FOR USE IN THE CULTURING OF MARINE ORGANISMS. Chesapeake Sci. 17 (1): 61-64. Mar. 1976. SFA 21(2).

[49 Oyster Pond Rd., Falmouth, MA 02540] Marine Biological experiments often require controlling the seawater temperature in flowing culture systems. This heating or cooling of seawater is generally accomplished with a heat exchanger and an intermediary fluid. The major consideration in the choice of a heat exchanger is often finding a unit whose material is compatible with seawater, with the culture organisms and with the objectives of the individual experimental programs. Researchers, over the years, have used a variety of heat exchanger types and materials. Unfortunately there is currently no central source of information on this accumulated experience.

Commercially available heat exchangers, used mostly in the chemical process industries, have been successfully used for marine research. Some of these are made of carbon, glass, teflon, titanium and stainless steel. In addition, there is a variety of heat exchanger designs that can be readily made from easily aquired materials. The advantages and problem areas with different heat exchanger types and materials are discussed. Also explored are possible approaches for the application of heat exchangers to large scale marine aquaculture.

76-000543 Kuchnow, K. P.; Foster, R. S. IV THERMAL TOLERANCE OF STORED /FUNDULUS HETEROCLITUS/ GAMETES: FERTILIZABILITY AND SURVIVAL OF EMBRYOS. J. Fish. Res. Board Can. 33 (4,1): 676-680. Apr. 1976. In English with French summ. SFA 21(2).

[Dep. Biol., Texas A&M Univ., College Station 77843] /Fundulus heteroclitus/ ova were tested for fertility after storage intervals of 6, 12, 24, 48, 72, and 96 h over a temperature range of 0-30 C (2-degree increments). Sperm were tested after storage intervals of 2, 4, 6, 12, 15, and 24 h over the range of 0-20 C. Ova retained fertility best at 10-14 C, with fertilization rates of 93, 80, and 46 percent after 24, 48, and 72 h, respectively. Sperm retained fertility best at 0-4 C, with fertilization rates of 85, 59, and 25 percent after 2, 4, and 6 h, respectively. The shorter time that sperm retained fertility, compared to the ova, was attributed to sperm activity, since all gametes tested were obtained by stripping, which initiates motility in /F. heteroclitus/ sperm.

Variation in mortality in stored ova could be attributed to temperature differences. No relation between sperm storage temperatures and embryo mortality was found.

76-000544 McConnell, W. J.; Jackson, U. T. A METHOD FOR PRECALIBRATING RE-OXYGENATION RATES IN EXPERIMENTAL CONTAINERS. Trans. Am. Fish. Soc. 105 (2): 343-346. Mar. 1976. SFA 21(2).

[Colo. Coop. Fish. Res. Unit, Colo. State Univ., Fort Collins 80523] A precalibration procedure is outlined that ensures sufficient re-oxygenation to balance oxygen demand in static containers used to hold small aquatic animals for experiment or observation. The procedure is based of predicting the rate of controlled turbulance at which re-oxygenation balances oxygen consumption at some acceptable oxygen concentration below saturation.

GENERAL LIMNOLOGY AND OCEANOGRAPHY

76-000545 Boland, D. H. P. TROPHIC CLASSIFICATION OF LAKES USING LANDSAT-1 (ERTS-1) MULTISPECTRAL SCANNER DATA. U.S. Environ. Prot. Agency Ecol. Res. Ser. EPA-600/3-76-037. xviii + 245p. Apr. 1976. SFA 21(2).

[U.S. EPA, Corvallis Environ. Res. Lab., Corvallis, OR 97330] This study evaluates the Earth Resources Technology Satellite One (ERTS-1; /i.e./, LANDSAT-1) multispectral scanner (MSS) as a means of estimating lacustrine trophic state and the magnitude of two trophic state indicators. Numerical classificatory methods are employed to ascertain the trophic character of 100 lakes in Minnesota, Wisconsin, Michigan, and New York using the trophic indicators: chlorophyll /a/, total organic nitrogen, inverse of Secchi disc transparency, conductivity, total phosphorus, and an algal assay yield.

76-000546 Gaufin, A. R.; Prescott, G. W.; Tibbs, J. F. LIMNOLOGICAL STUDIES OF FLATHEAD LAKE MONTANA: A STATUS REPORT. U.S. Environ. Prot. Agency Ecol. Res. Ser. EPA-600/3-76-039. vii + 85p. Apr. 1976. SFA 21(2).

[Univ. Mont., Missoula 59801] Flathead lake, a dimictic oligotrophic lake located in western Montana has been the subject of several investigations beginning with Forbes' study of aquatic invertebrates in the lake in 1893. Young in 1935 presented the results of four years of data collecting on the chemistry and biology of the lake. During the last ten years (1964-1974) a number of limnological studies have been conducted dealing with the physical, chemical, and biological characteristics of the lake. The objectives of these studies have been to determine the standing crop of phytoplankton and zooplankton during all seasons of the year, to observe the succession, distribution and diversity of planktonic forms, to determine the role of chemical nutrients in relationship to phytoplankton productivity, and to study fish population trends, life histories and seasonal fish distribution of the Flathead Lake system.

The composition of the algal flora of Flathead Lake in number of species so far reported is Chlorophyta 102 species (17.5 percent); Cyanophyta 40 species (7 percent); Chrysophyceae 12 species (2.1 percent); Bacillariophyceae 399 species and varieties (69.8 percent); Pyrrhophtya 13 species (2.0 percent); Xanthophyceae 4 species; Euglenophyta 1 species; and Cryptophyta 2 species. The Chrysophyta as a phylum (Diatoms and Chrysophyseae) thus constitutes by far the dominant floral group. In this respect the lake shows an oligotrophic character remindful of the oligotrophic flora in arctic lakes.

Nitrates and phosphates are relatively low as might be expected. Levels of these critical nutrients that have been reported are high enough to occasionally support plankton blooms. That extensive blooms do not occur is possibly due to oligotrophic features such as low temperatures and low concentrations of organic acids and vitamins.

The more common forms of zooplankton found in the lake, /Daphnia/ spp., /Kellicottia longispina/, /Keratella cochlearis/, /Cyclops bicuspidatus thomasi/, and /Diaptomus ashlandi/, compose a community similar to that described by Sheffer and Robinson (1949) for Lake Washington. The distribution of /Daphnia/ spp. in the lake has been of particular interest because their temporal and spatial distributions seem to be influenced primarily by temperature.

A total of 8,912 fish were collected in 163 net sets during the fish sampling program on the lake from November 1967 through December 1971. Fifteen major fish species were collected with the lake whitefish, kokanee salmon, Dolly Varden, and lake trout being the most common game species in that order of abundance.

76-000547 Lynch, M.; Shapiro, J. APPARENT VS. NON-APPARENT EUTROPHICATION--THE IMPORTANCE OF FISH PREDATION. Presented at the 39th Annu. Meeting, Am. Soc. Limnol. Oceanogr., Savannah, Ga., June 21-24, 1976. f1976. SFA 21(2).

[Limnol. Res. Cent., Univ. Minn., Minneapolis 55455] Eutrophication is generally recognized as a condition of low transparency resulting from an abundance of phytoplankton caused by nutrient enrichment. We suggest that these manifestations of eutrophication are very dependent on fish predation expressed through the alteration of zooplankton community structure. A six-week experiment in which we exposed a series of enclosures to various intensities of fish predation supports our argument. Although total phosphours remained similar in all enclosures, chlorophyll /a/ increased from 1 to 75 mg/$m^3$ with increasing fish predation, and transparency went from greater than 2 M to less than 1 M. Increasing fish predation simplified the cladoceran community, the larger species sequentially beccming extinct, until only /Bosmina longirostris/ remained at highest predation levels. Rotifers increased with predation intensity both in total abundance and species richness. Algal strategies against intense grazing pressure appear to include small size and rapid reproductive rate, very large size, or colonialism. Nonetheless, intense grazing by large cladocerans prevents even these species from reaching high abundance. The immediate response to removal of /Daphnia pulex/ by predation is the rapid development of colonial forms and a decline of the smallest species. These results suggest that current endeavors for water clarity and certain fish management schemes are incompatible.

76-000548 Mann, C. R. PHYSICAL OCEANOGRAPHY IN CANADA. J. Fish. Res. Board Can. 33 (6): 1411-1433. June 1976. In English with French summ. SFA 21(2).

[Atlantic Oceanogr. Lab., Bedford Inst. Oceanogr., Dartmouth, NS B2Y 4A2, Canada] The basic research program in physical oceanography in Canada is described. The use of physical oceanographic information in resource development, environmental assessment, prediction of climate, and other marine activities is examined. A major finding of the study is that the use of physical oceanographic information has increased and will continue to do so. Basic research in fisheries oceanography, ocean climatology, and numerical modeling is inadequate. Recommendations are formulated to improve basic research and services.

76-000549 Sanville, W. D.; Gahler, A. R.; Searcy, J. A.; Powers, C. F. STUDIES ON LAKE RESTORATION BY PHOSPHORUS INACTIVATION. U.S. Environ. Prot. Agency Ecol. Res. Ser. EPA-600/3-76-041. vi + 47p. Apr. 1976. SFA 21(2).

[U.S. EPA, Corvallis Environ. Res. Lab., Corvallis, OR 97330] Sodium aluminate effectiveness as a nutrient inactivant to control eutrophication was evaluated in Cline's Pond, a 0.4 ha farm pond near Corvallis, Oregon. Ability of the inactivant tc scavenge phosphate in the water column, to prevent resolublization of phosphate, and to inhibit primary production was of primary concern. Evaluation was based on limnological comparison of the pond following inactivation with antecedent data obtained over the preceeding two years. In general, total phosphate, ammonia, total Kjeldahl nitrogen, iron, manganese, and algal standing crop were lower following inactivation than during the two previous years. Increased transparency and more uniform distribution of dissolved oxygen and pH suggested an improvement in water quality. A shift in dominance from blue-green to green algae was indicated. Firm conclusions as to the effectiveness of the sodium aluminate treatment cannot be drawn, however, because of a

76-000549 CONTINUED
lack of uniformity of limnological parameters in the pond during the two years before initiation of the experiment.

PHYSICAL LIMNOLOGY AND OCEANOGRAPHY

76-000550 Ochalek, R. M. THERMAL BUDGETS, STABILITY OF STRATIFICATION, AND WORK OF THE WIND IN A SMALL WEST VIRGINIA RESERVOIR. Proc. W. Va. Acad. Sci. 48 (1): 22. 1976. Abstract only. SFA 21(2).
[Dep. Biol., W.Va. Univ., Morgantown 26506] The thermal budgets of Spruce Knob Lake, a small reservoir (10.4 ha) located in Randolph Co., W.Va., were calculated using Birge's method. The annual heat budgets for two years were nearly identical ranging from 4236 cal/cm² the first year (1973-74) to 4098 cal/cm² the next year (1974-75). The summer heat budget was 3586 cal/cm² in 1973, 3689 cal/cm² in 1974 and 3631 cal/cm² in 1975. The winter heat budget was 301 cal/cm² in 1973 and 468 cal/cm² in 1974. Stability was calcualted using Idso's modification of the Schmidt equation. The work of the wind was also calculated using Birge's method. The lake was artificially aerated using compressed air in the summer of 1974 and in 1975 a mechanical aerator was used. Following the first two weeks of aeration in 1974 stability decreased from 9.2 g-cm/cm² to 2.76 g-cm/cm²; however, stability was not found to be significantly different from the summer of 1973. Analysis of flow data shows 0.0406 cal/cm²/yr is contributed to the lake's heat budget by stream inflow.

76-000551 Pond, S. NUMERICAL MODELING OF OCEAN CIRCULATIONS. J. Fish. Res. Board Can. 33 (6): 1434-1450. June 1976. In English with French summ. SFA 21(2).
[Inst. Oceanogr., Univ. British Columbia, Vancouver, BC V6T 1W5, Canada] This report was prepared as background material for the Fisheries Research Board of Canada study on oceanography in Canada. Models of the large-scale or general circulation of the ocean are examined first. The general approach to such modeling and a series of models are described and the status of modeling is discussed. It appears that such models are another useful way to study the ocean. However, the resolution of present models is not sufficient to include all possibly important dynamic effects. Besides the resolution problem, the lack of sufficient data, particularly of currents, makes it difficult to tell how well the models reproduce reality. Data collection programs, designed to use observational knowledge and results of analytical and numerical modeling, will be required for input and verification of numerical models. The use of models should reduce the effort to where it is practicable though difficult and likely to tax the oceanographic community's resources to the limit. Modeling of coastal regions, semienclosed seas, and estuaries is described and some models of the ocean mixed layer are presented. The upper-layer models are required to provide better bottom boundary conditions for numerical atmospheric models to predict weather and climate in addition to the oceanographic results they produce. An assessment of the usefulness of numerical models for prediction is attempted. Finally, suggestions are made for further development of the Canadian program of numerical modeling. --From abstr.

76-000552 Ulanowicz, R. E. MODELING THE CHESAPEAKE BAY AND TRIBUTARIES: A SYNOPSIS. Chesapeake Sci. 17 (2): 114-122. June 1976. SFA 21(2).

[Univ. Md., Chesapeake Bay Lab., Solomons 20688] The last decade has seen the development and application of a spectrum of physical and numerical hydrographic models of the Chesapeake Bay and its tributaries.

The success of the James River Hydraulic Model has initiated the construction of an estuarine hydraulic model of the entire Chesapeake System.

Numerical analogues for hydrographic behavoir and contaminant dispersion in one-, two-, and three-dimensional model estuaries exist for various regions of the Bay. From an engineering viewpoint, one-dimensional models are sufficiently advanced to be routinely employed in aiding management decisions. Bay investigators are playing leading roles in the development of two- and three-dimensional models of estuarine flows.

## CHEMICAL LIMNOLOGY AND OCEANOGRAPHY

76-000553 Mann, C. R. CHEMICAL OCEANOGRAPHY IN CANADA. J. Fish. Res. Board Can. 33 (6): 1451-1469. June 1976. In English with French summ. SFA 21(2).

[Atlantic Oceanogr. Lab., Bedford Inst. Oceancgr., Dartmouth, NS B2Y 4A2, Canada] Chemical oceanography is the most recently developed discipline of oceanography science in Canada. Cnly in the last few years have groups of chemists been formed in Canadian oceanographic institutions. Many of the chemists are new to chemical oceanography, they are still in the processes of developing their knowledge and sorting out those aspects of research in chemical oceanography that should be pursued in Canada.

The problems posed by pollution have accelerated the development of chemical oceanography and have also had a considerable influence on the subject matter studied by the chemists. Concern with pollution has led to a concentration of the effort in estuarine and coastal zone problems. This will continue into the forseeable future. It is desirable that the Canadian program be extended to include arctic studies, the continental shelves, and an effort should be made to acquire baseline into waters around Canada.

More attention should be given to chemical oceanographic studies in support of fisheries, and the oceanography of the deep sea should not be neglected.

Canada can not hope to undertake research in all aspects of such a complex subject as chemical oceanography. The best strategy at the present stage of development is to be selective, develop science of significance in the laboratories as well as addressing practical problems, and to ensure that there is adequate contact with work done elsewhere in the world.

76-000554 Sinclair, M.; El-Sabh, M.; Brindle, J. R. SEAWARD NUTRIENT TRANSPORT IN THE LOWER ST. LAWRENCE ESTUARY. J. Fish. Res. Board Can. 33 (6): 1271-1277. June 1976. In English with French summ. SFA 21(2).

[Sect. Oceanogr., Univ. Quebec, Rimouski, PQ G5L 2A1, Canada] A transect across the lower St. Lawrence estuary was occupied to estimate volume transport and nutrient distributions (total dissolved nitrogen and phosphorus, and silicate) during February and May through September. Seaward transport was restricted to the upper 50 m and varied from 17 X $10^3$ $m^3/s$ (August) to 129 X $10^3$ $m^3/s$ (May). Nutrient

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and volume transport data are combined to estimate seasonal variability in monthly surface nutrient transport towards the Gulf of St. Lawrence. The estimates vary as follows: 0.72-6.72 X $10^3$ tons N/mo, 0.05-0.48 X $10^3$ tons P/mo and 0.50-6.73 tons Si/mo. Ratios between monthly freshwater input into the estuary and the corresponding values for net seaward transport, which varied from 1.1 to 9.4, are combined with annual data (1960-73) on monthly freshwater input into the estuary to estimate potential annual variability in seaward transport for each of the above months. Observed nutrient data, with the above transport estimates, suggest the possible range in monthly seaward nutrient transport that would be associated with the annual variability in monthly freshwater input into the estuary. Seaward nitrogen transport from May through September, estimated at 2.3 X $10^4$ tons, is considered in relation to published data on the primary production in the western part of the Gulf of St. Lawrence. The estuary supplied a smaller amount of nutrients to the Gulf than has previously been assumed.

BENTHOS

76-000555 de March, B. G. E. SPATIAL AND TEMPORAL PATTERNS IN MACROBENTHIC STREAM DIVERSITY. J. Fish. Res. Board Can. 33 (6): 1261-1270. June 1976. In English with French summ. SFA 21(2).
[Fish. Mar. Serv., Freshwater Inst., Winnipeg, MB R3T 2N6, Canada]
The relationship between the characteristics of a stream community and sediments were studied for 1 yr in a small unpolluted river with a morainal substrate. Recognizable faunal assemblages were associated with silt or silt fill, sand or sand fill, and large boulders. The fauna in sediments of mean particle sizes coarser than sand but finer than boulders was characterized by a high variability due largely to temporal successions of morphologically related species. It was found that the number of species was directly proportional to mean particle size (in phi units) in spring when the sediments were well sorted, but the relationship broke down as the sediment interstices filled in. In late fall when the sediments were badly sorted, the number of species is perhaps more related to the sorting coefficient of the sediments. The relevance of these findings to studies of pollution is discussed.

76-000556 McKone, W. D. QUANTITATIVE STUDIES OF STREAM DRIFT WITH PARTICULAR REFERENCE TO THE MCLAY MODEL. Ph.D. dissertation, Univ. British Columbia f1975. From Diss. Abstr. Int. B Eng. 36(12), 1976. SFA 21(2).
Most of invertebrates drifted in increasing numbers shortly after sunset. Daily variations in the drift rate occurred for various species although no changes were observed in physical conditions along the channel. The McLay model thus makes assumptions of uniformity of distribution which may not be met in field conditions.
Some species introduced into artificially induced laminar flow actively moved toward the substrate by swimming, and drifted a shorter distnace than that predicted by the McLay model, while by contrast those that were passive drifted farther than predicted. Increasing substrate density of a particular species caused added animals to drift farther before they could find sites for settling.
The time required for an introduced pulse to pass downstream was longer than predicted considereng stream velocity. For several species the distance drifted at different velocities was found to be best described by a power function suggested by Ellict (1971 ), but modified by the use of mean rather than modal velocity.
The rate at which dead /Epeorus/ left the drift was linearly related

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to distance. Thus, leaving the drift was not a random process for dead animals.

Various combinations of disturbance of the substrate and the complete filtration (blockage) of drift, including the maintenance of a blockage for ten days, were carried out under differing conditions of light intensity and water velocity. The assumption of the McLay model of additivity of pulses of animals was validated but the quantity introduced into the drift at each disturbance varied between and within species.

Below a filtration of drifting species, numbers of animals which "put up" into the drift naturally, conformed to the predictions of the model, with each species exhibiting a characteristic rate of leaving the drift for a given water velocity and light intensity.

When a blockage was maintained for several days, the observed drift of successive days was a satisfactory fit to that predicted; but on successive days larger numbers entered the drift just below the blockage than was predicted, possibly indicating support for the hypothesis of intergravel upstream movement.

Estimates of the substrate density of organisms can be based on predictions of the McLay model, but only for species and age groups that are actively engaged in drifting.

It is concluded that the McLay model provides a simple, holistic conception of the process of stream drift. However, variations in the substrate density, flow conditions, behavior of the various kinds of organisms including drift behavior and upstream migration combine to provide many circumstances in which the model is inadequate. --From abstr.

76-000557 Pollock, L. W. MARINE FLORA AND FAUNA OF THE NORTHEASTERN UNITED STATES. TARDIGRADA. NOAA Tech. Rep. NMFS Circ. 394. iii + 25p. May 1976. SFA 21(2).

[Dep. Zool., Drew Univ., Madison, NJ 07940] The manual includes an introduction to the general biology, an illustrated key, and annotated systematic list, a selected bibliography, and an index to the Tardigrada of the marine coastal areas of the world to a depth of 5,000 m

PLANKTON

76-000558 Evans, M. S.; Hawkins, B. E. A COMPARATIVE ANALYSIS OVER SEVERAL YEARS OF SPRING ZOOPLANKTON POPULATIONS IN SOUTHEASTERN LAKE MICHIGAN. Presented at the 39th Annu. Meeting, Am. Soc. Limnol. Oceanogr., Savannah, Ga., June 21-24, 1976. f1976. SFA 21(2).

[Great Lakes Res. Div., Univ. Mich., Ann Arbor 48104] Data provided by survey cruises covering a 250-km$^2$ grid in scutheastern Lake Michigan in April 1972, 1973, and 1974 indicated that zooplankton varied in abundance and distribution from year to year; these variations were a function, in part, of lake temperatures. Zooplankton were most abundant (mean 8,892/m$^3$) in 1973 when surface water temperatures were highest (mean 8.6C); zooplankton were less abundant in 1972 (4,608/m$^3$) and in 1974 (3,861/m$^3$) when water temperatures were lower (3.3C, 6.9C, respectively). The dominant taxa in 1972 were adult /Cyclops/ spp. and /Diaptomus/ spp., in 1973 nauplii, and in 1974 all three taxa. Principal component analyses of the data failed to show any pattern to zooplankton distributions over the survey area in 1972. In 1973 and 1974 zooplankton were least abundant within 1 km of shore and were dominated by small organisms; zooplankton were most abundant 4 to 11 km offshore and were dominated by the larger zooplankton. A possible mechanism causing the spatial patterns was the inshore

76-000558 CONTINUED
migration and reproduction of planktivorous fish in response to the warming of the inshore area and the size-selective predation by these fish on the largest components of the zooplankton.

76-000559 Loeffelman, P. H.; Buikema, A. L., Jr. EFFECT OF A PUMPED-STORAGE OPERATION ON SELECTED ZOOPLANKTERS. Presented at the 39th Annu. Meeting, Am. Soc. Limnol. Oceanogr., Savannah, Ga., June 21-24, 1976. f1976. SFA 21(2).
[VPI & SU, Blacksburg, VA 24061] Zooplankton samples were collected from 2 sites on Smith Mountain Reservoir, Va., a pumped-storage impoundment. Samples were collected for a seven day period in August, 1975 during pumped-back and generation modes. The effect of this operation was examined on the rotifers /Keratella cochlearis/, /Polyarthra vulgaris/, /Filinia limnetica/ and /Hexarthra intermedia/, and the cladoceran /Bosmina longirostris/. Generally the zooplankton densities near the dam were greater than those at a site 1.5 km from the dam. Possible reasons for the increase in zooplankton densities include: 1) accumulation of stunned and moribund animals; 2) nutrient accumulation and increased food production; 3) warmer temperatures at lower depths; and 4) the effect of widely fluctuating temperatures on reproduction. Pumped-storage operations reduced the clumping common to vertically distributed populations. This was probably due to the combined effects of turbulence and warmer temperatures at lower depths. Possible pumped-storage effects may be manifested at lower depths some distance from the dam.

76-000560 Parker, R. A. PHOSPHATE REDUCTION AND RESPONSE OF PLANKTON POPULATIONS IN KOOTENAY LAKE. U.S. Environ. Prot. Agency Ecol. Res. Ser. EPA-600/3-76-063. vii + 63p. May 1976. SFA 21(2).
[Wash. State Univ., Pullman 99163] The purpose of this research project was to determine the effects of reducing by 90 percent the soluble inorganic phosphate input to Kootenay Lake, British Columbia, Canada, a significant link in the Columbia River system governed by United States-Canadian treaty. Measurements on temperature, transparency, inorganic and organic phosphate, nitrate, ammonium, chlorophyll /a/, copepods, and cladocerans were made during 1971-75, and compared with observations made for three years prior to phosphate reduction in 1969. Only a slight decrease in chlorophyll occurred, although there were important changes in species composition. Total zooplankton levels were not affected, however one genus (/Daphnia/) has virtually disappeared. Data indicate that primary production in the lake was nitrogen limited prior to 1969, phosphate limited two years later. These changes may also be related to the completion in 1972 of Libby Dam in Montana, upstream from the lake on the Kootenay River. --From abstr.

76-000561 Porter, K. G. ENHANCEMENT OF ALGAL GROWTH AND PRODUCTIVITY BY GRAZING ZOOPLANKTON. Science 192 (4246): 1332-1334. 25 June 1976. SFA 21(2).
[Dep. Evol. Ecol. Biol., Div. Biol. Sci., Univ. Mich., Ann Arbor 48109] Colonies of the common planktonic green alga, /Sphaerocystis schroeteri/, are only partially disrupted and assimilated by /Daphnia magna/, a natural predator. The /Daphnia/ break up the outer protective gelatinous sheath that surrounds /Sphaerocystis/ colonies, but most of the algal cells emerge from /Daphnia/ guts intact and in viable condition. During gut passage, these viable cells take up nutrients, such as phosphorus, both from algal remains and from /Daphnia/ metabolites. This nutrient supply stimulates algal carbon fixation and cell division. Enhanced algal growth, observed after gut passage, can compensate for the minor losses to the population caused

76-000561 CONTINUED
by grazing. Nutrients regenerated by grazers may produce the summer bloom of gelatinous green algae during the seascnal succession of lake phytoplankton.

76-000562 Sameoto, D. D. DISTRIBUTION OF SCUND SCATTERING LAYERS CAUSED BY EUPHAUSIIDS AND THEIR RELATIONSHIP TO CHLOROPHYLL /A/ CONCENTRATIONS IN THE GULF OF ST. LAWRENCE ESTUARY. J. Fish. Res. Board Can. 33 (4,1): 681-687. Apr. 1976. In English with French summ. SFA 21(2).

[Fish. Mar. Serv., Mar. Ecol. Lab., Bedford Inst. Oceanogr., Dartmouth, NS B2Y 4S2, Canada] A 3-yr study in the Gulf of St. Lawrence estuary using a 120-kHz sounder has shown the existence of a large population of euphausiids consisting of the species /Thysanoessa raschii/, /T. inermis/, and /Meganyctiphanes norvegica/. The sound scattering produced by these animals varied in intensity as the density and biomass $m^{-3}$ of the animals. Chlorophyll /a/ concentrations measured within 5 m of the surface at the same time as the sound scattering layers showed a significant correlation between the numbers of euphausiids $m^{-3}$ and the concentration of chlorophyll /a/ $m^{-3}$.

## MORPHOLOGY

76-000563 Bauchot, R.; Platel, R.; Ridet, J.-M. BRAIN-BODY WEIGHT RELATIONSHIPS IN SELACHII. Copeia 1976 (2): 305-310. May 1976. SFA 21(2).

The study of the brain-body weight relationships in Selachii yields the following results. The intraspecific coefficient of allometry (calculated in the species /Scyliorhinus canicula/, /Mustelus canis/ and /Torpedo marmorata/) is around 0.50, a value very close to that observed in Teleostei and higher than that of tetrapod vertebrates. The interspecific coefficient of allometry (computed from values determined for 16 species of sharks and rays) is very high (0.94) and close to that which characterizes the insectivore-primate group (0.93).

This coefficient probably is related to form conservation, and evolution favoring encephalization of large species. In respect to encephalization, these fishes are on the same level as certain birds and mammals.

76-000564 Bonham, K. SPECIFIC GRAVITY OF SALMONID EGGS. Trans. Am. Fish. Soc. 105 (2): 351-352. Mar. 1976. SFA 21(2).

[Coll. Fish., Univ. Wash., Seattle 98915] Conditions bearing on 43 determinations of the specific gravity of the eggs of chinook (/Oncorhynchus tshawytscha/) and coho (/O. kistuch/) salmon and of rainbow trout (/Salmo gairdneri/) are described. Mean and coefficient of variation of the specific gravity of 13 batches of ova before water-hardening were 1.076 ± 0.84 percent, and of 30 batches of zygotes after water-hardening were 1.064 ± 0.83 percent, while for all 43, 1.066 ± 1.38 percent. Three dry/wet and ash/wet weight ratios respectively averaged 0.344 ± 4.9 percent and 0.00872 ± 3.4 percent.

76-000565 Burdak, V. D. "RUNOFF RILLS" ON FISH SCALES. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (3): 451-452. 1974. SFA 21(2).
[Inst. Biol. South. Seas, Ukrainian Acad. Sci., Sevastopol, USSR] With regard to "runoff rills" on fish scales, they arise in phylogeny as an optimum variant of a streamlined surface. Such a surface provides the minimum possible frictional resistance as a result of the weakening of turbulent pulsations in the boundary layer. This is quite logical, since there is an inevitable economy in the energy expended by the fish on movement. --From text

76-000566 DeVane, J. C., Jr. AN ALBINO STRIPED BURRFISH /CHILOMYCTERUS SCHOEPFI/ (WALBAUM). Chesapeake Sci. 17 (2): 128. June 1976. SFA 21(2).
[NMFS, Atlantic Estuarine Fish. Cent., Beaufort, NC 28516]

76-000567 Fava, J. A., Jr.; Tsai, C.-F. TUBERCULATION OF THE PEARL DACE, /SEMOTILUS MARGARITA/ (PISCES: CYPRINIDAE). Copeia 1976 (2): 370-374. May 1976. SFA 21(2).
[Cent. Environ. Estuarine Stud., Univ. Md., College Park 20742]

76-000568 Fedorova, G. V. MORPHOMETRIC CHARACTERISTICS OF THE BALTIC LAKE SMELT [/OSMERUS EPERLANUS EPERLANUS/ MORPHA /SPIRINCHUS/] OF LAKES ILMEN AND SELIGER. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (2): 203-208. 1974. SFA 21(2).
[Gos NIORKh, Lenningrad, USSR] It is established that significant differences exist between the smelts of Lakes Ilmen and Seliger with respect to a number of characters. This confirms the assumption that the smelts of these waters are ecological forms of the Baltic lake smelt. The smelt of Lake Ilmen is closer to that of Lake Vuoksa than to that of Lake Seliger with respect to many morphometric indicators.

76-000569 Fuiman, L. A. NOTES ON THE EARLY DEVELOPMENT OF THE SEA RAVEN, /HEMITRIPTERUS AMERICANUS/. NOAA Fish. Bull. 74 (2): 467-470. Apr. 1976. SFA 21(2).
[Dep. Nat. Resour., Cornell Univ., Ithaca, NY 14853]

76-000570 Litvinenko, N. N. COLORATION AND OTHER MORPHOLOGICAL CHARACTERS DISTINGIUSHING JUVENILE /SEBASTES FASCIATUS/ FROM JUVENILE /S. MENTELLA/ (SCORPAENIDAE). J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (4): 591-595. 1974. SFA 21(2).
[Zool. Inst., USSR Acad. Sci., Lenningrad, USSR]

76-000571 Payusova, A. N.; Koreshkova, N. D. MORPHOLOGICAL CHARACTERISTICS OF THE GILL RAKERS IN THE ISSYK-KUL DACE [/LEUCISCUS SCHMIDTI/] AND [/L. BERGI/] KASCHKAROV. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (2): 186-192. 1974. SFA 21(2).
[Biol. Fac., Moscow Univ., Moscow, USSR] The structure of the gill rakers was investigated in the Issyk-Kul dace: the "chebak" and the "chebachok." Two forms of rakers (straight and branched) were detected and it was found that their number on the 1st gill arch fluctuated considerably. All the fish were divided into four groups (A, B, C, D) differing in the number of straight and branched rakers. The proportions of these groups in sexually mature specimens of the chebak and the chebachok do not depend on sex, age and the region inhabited; group A predominates in the chebak and group B in the chebachok, with the exception of immature specimens of the chebachok, in which group A

76-000571 CONTINUED
predominates, as in the chebak. The difference between the chebak and the chebachok in the number of straight and branched gill rakers is connected with differences in the food of these fishes.

76-000572 Popper, A. N. ULTRASTRUCTURE OF THE AUDITORY REGIONS IN THE INNER EAR OF THE LAKE WHITEFISH. Science 192 (4243): 1020-1023. 4 June 1976. SFA 21(2).
[Dep. Zool. Lab. Sens. Sci., Univ. Hawaii, Honolulu 96822] Hair cell polarization patterns were investigated on the sensory macule of the sacculus and lagena of the lake whitefish. The saccular hair cells are divided into four groups, with all of the cells within a group having the same orientation. Saccular orientations are anterior, posterior, dorsal, and ventral with respect to the axis of the animal. Two groups, one dorsal and one ventral, are found on the lagena. The saccular orientations are significantly different from those in tetrapods. Since this organ appears to have different functions in fish and tetrapods it is likely that the orientation patterns in fish are adapted to some aspect of audition--perhaps directional localization of sound.

76-000573 Shiganova, T. A. POSTEMBRYONIC DEVELOPMENT OF /HYGOPHUM BENOITI/ (MYCTOPHIDAE, PISCES). J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (5): 746-754. 1974. SFA 21(2).
[Inst. Oceanol., USSR Acad. Sci., Moscow, USSR] Consideration is given to early stages in the ontogeny of /Hygophum benoiti/ on the basis of material collected in the tropical and subtropical Atlantic between 1963 and 1972. An analysis is made of alterations in the shape and proportions of the body in the course of development, the sequence of ossification of individual parts of the skeleton, the course of inception and complete formation of the fins and gillrakers, and the nature of pigmentation in each stage.

76-000574 Verigina, I. A. THE STRUCTURE OF THE ALIMENTARY CANAL IN SOME OF THE NORTHERN BLENNIOIDEI. I. THE ALIMENTARY CANAL OF THE ATLANTIC WOLFFISH (/ANARRHICHAS LUPUS/). J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (6): 954-959. 1974. SFA 21(2).
[Zool. Mus., Moscow Univ., Moscow, USSR] The anatomical and histological structure of the alimentary canal was investigated in the Atlantic wolffish (/Anarrhichas lupus/) in relation to the nature of feeding. Adaptation to feeding on animals with a hard outer covering (mollusks, echinoderms) is expressed primarily in the structure of the head part of the alimentary canal: the existence of crushing grindstone-like teeth in the oral cavity and a pharyngeal apparatus ensuring the additional maceration of the food. The well-developed epithelial integument and the large number of mucous-secreting cells protect the digestive organs against damage by shell fragments. The existence of alveolar glands in the small stomach of the wolffish is a distinctive character. The alimentary canal of the wolffish is discussed in view of G. Sharskiy's theory concerning a tendency toward the loss of the stomach in fishes whose food contains a large quantity of calcium carbonate.

76-000575 Verigina, I. A.; Savvaitova, K. A. THE STRUCTURE OF THE ALIMENTARY CANAL IN MEMBERS OF SYMPATRIC CHAR POPULATIONS [GENUS /SALVELINUS/] FROM LAKE AZABACH'YE (KAMCHATKA). J. Ichthyol. (Engl. Transl. Vopr. Iktiol.) 14 (3): 404-412. 1974. SFA 21(2).
[Zool. Mus. Dep. Ichthyol., Moscow Univ., Moscow, USSR] A study has been made of the structural characteristics of the alimentary canal in chars of the genus /Salvelinus/ (predators and benthophages--mollusk eaters). It is concluded that is is possible to use some characters, in particular those relating to the structure of the different parts of the stomach, in differential diagnosis of these forms. The possible taxonomic status of the forms investigated is discussed.

76-000576 Yakovleva, A. S.; Shishmarev, V. M. A MORPHOLOGICAL DESCRIPTION OF THE TUGUN (/COREGONUS TUGUN/) OF THE MAN'YA RIVER. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (6): 983-986. 1974. SFA 21(2).
[Inst. Plant Anim. Ecol., Urals Sci. Cent. USSR Acad. Sci., USSR] In its systematic position the tugun of the Man'ya River belongs to the typical form described by L. S. Berg (1948). Sexual dimorphism is weakly expressed in the tugun investigated. The differences with respect to some meristic characters in the tugun from different regions of Siberia are probably to be explained by the influence of ecological conditions. --From concl.

PHYSIOLOGY

76-000577 Alcorn, S. R. TEMPERATURE TOLERANCES AND UPPER LETHAL LIMITS OF /SALMO APACHE/. Trans. Am. Fish. Soc. 105 (2): 294-295. Mar. 1976. SFA 21(2).
[Midwest Res. Inst., 425 Volker Blvd., Kansas City, MO 64110] Fingerlings of the endangered trout species /Salmo apache/ Miller were subjected to increasing temperatures to determine upper lethal temperature limits. Most fish refused to take food at temperatures above 20 C. Equilibrium loss occurred between 21.2 C and 22.3 C. Death occurred when temperatures exceeded 23 C.

76-000578 Avni, A. A.; Soin, S. G. ADAPTIVE CHARACTERISTICS OF THE EMBRYOGENY OF /NOTHOBRANCHIUS GUENTHERI/ IN CONNECTION WITH EXISTENCE IN TEMPORARY TROPICAL HABITAT. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (5): 735-746. 1974. SFA 21(2).
[Dep. Ichthyol., Moscow Univ., Moscow, USSR] A study has been made of embryonic adaptations in the development of /Nothobranchius guentheri/ in connection with spawning in waters that periodically desiccate, where incubation occurs without water for a considerable period. Such characteristics include the ability of the embryos to enter a lengthy diapause, the formation of a special embryonic membrane analagous to an amnion, the great duration of embryonic development and hatching in an active larval state. The epiboly of the blastoderm in which the amnion forms is not acccmpanied by gastrulation, which occurs after the closure of the yolk plug.

76-000579 Bishop, D. G.; James, D. G.; Olley, J. LIPID COMPOSITION OF SLENDER TUNA (/ALLOTHUNNUS FALLAI/) AS RELATED TO LIPID COMPOSITION OF THEIR FEED (/NYCTIPHANES AUSTRALIS/). J. Fish. Res. Board Can. 33 (5): 1156-1161. May 1976. In English with French summ. SFA 21(2).

[Sch. Biol. Sci., Macquarie Univ., North Ryde, 2113, Sydney, Australia] The depot lipids of specimens of slender tuna (/Allothunnus fallai/) were characteristic of the zooplankton (/Nyctiphanes australis/) on which each was feeding. The lipids of the "krill" and of the depot fats were unusually rich in eicosaenoic and docosahexaenoic acids, although the fatty acid composition of samples of "krill" from individual tuna stomachs varied markedly and this variation was reflected in the fatty acid composition of the tuna depot lipids.

Because of the nature of their diet, the composition of the depot lipids of the slender tuna varied significantly from those of other tuna species. However, the liver lipids of the slender tuna were more characteristic of all fish liver oils.

76-000580 Brewer, G. D. THERMAL TOLERANCE AND RESISTANCE OF THE NORTHERN ANCHOVY, /ENGRAULIS MORDAX/. NOAA Fish. Bull. 74 (2): 433-445. Apr. 1976. SFA 21(2).

[Allan Hancock Found., Univ. South. Calif., University Park, Los Angeles 90007] An experimental, flow-through seawater system, constructed to maintain juvenile and adult northern anchovy, /Engraulis mordax/, and rear embryos and larvae through yolk-sac absorption under controlled temperature and photoperiod regimes, was used to determine aspects of thermal tolerance, resistance, rates of acclimation, and some effects of temperature on the development and growth of the anchovy.

Thermal tolerance was determined for juvenile and adult fish, acclimated to six constant temperatures between 8 and 28C. Thermal resistance (minutes unitl death for fish exposed to a lethal temperature) was independent of photoperiod and fish size; however, females proved more resistant than males, and resistance decreased at night. Acclimation (as measured by resistance) from 12 to 20C was nearly complete after 2-day exposure to the higher temperature; acclimation from 20 to 12C was nearly complete after 5-day exposure to the lower temperature. Fish subjected to fluctuating water temperatures between 12 and 20C proved less resistant to cold than a 12C (constant) acclimated group and less resistant to heat than a 20C (constant) acclimated group.

Thermal tolerance was determined for larvae in the yolk-sac stage, acclimated to four constant temperatures between 12 and 24C. Although hatching occurred at temperatures as high as 29.5C and as low as 8.5C, the percentage of normally developed larvae equaled that of controls (incubated at 16C) only between temperatures of 27.0 and 11.5C. Embryos in the blastodisc stage proved most sensitive to acute temperature increases when compared to embryos in the blastopore closure stage and larvae in the yolk-sac stage. These same three stages proved insensitive to acute temperature decreases to 0.5C for 60-min exposure periods.

Temperature is discussed in relation to anchovy distribution and survival under natural and artificially created thermal conditions.

76-000581 Buyanov, N. I.; Antonenko, T. M. CESIUM-137 CONCENTRATION HYDROBIONTS, WATER AND SUBSTRATE OF BODIES OF WATER WITH A DIFFERENT MINERAL COMPOSITION. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (1): 159-163. 1975. SFA 21(2).

[PINRO, Murmansk, USSR] Cesium-137 concentration in fishes, conditioned by global atmospheric precipitations, is in inverse relation to the mineralization of the water. Cesium-137 concentration in fishes from higher trophic levels is higher than in organisms which are the representatives of the first trophic levels. The presence of a direct "trophic level effect" allows the predominant role of food in the entry into the fish organism of radioisotopes to be indirectly demonstrated. --From concl.

76-000582 Chekunova, V. I. THE RATE AND LEVEL OF METABOLISM IN FISHES OF DIFFERENT ECOLOGICAL GROUPS. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (2): 272-283. 1974. SFA 21(2).

[VNIRO, Moscow, USSR] It has been established that the level of the ordinary metabolism of sea fishes measured within the temperature limits of their range is dependent on mode of life (membership of a benthic, benthopelagic or pelagic ecological grouping) and, within the same ecological group, on the geographic location of the species range, which determines the degree of stenothermy.

Metabolic level may vary appreciably in fishes in the course of the year. The amplitude of these alterations depends on the range of temperature fluctuations within the range of the species. These fluctuations are indiscernible in the most stenothermal species and slight in the fishes of northern latitudes, but in the fishes of our southern seas the extreme values of metabolic level differ by 5 to 6 times.

76-000583 Dolinin, V. A. MAIN PARAMETERS OF THE RESPIRATORY FUNCTION IN FISHES DURING ALTERATION IN RESPIRATORY ACTIVITY. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (1): 124-132. 1975. SFA 21(2).

[USSR Acad. Sci., Novosibirsk, USSR] The dependence of ventilation volume, coefficient of uptake of oxygen from the water and frequency of respiratory movements in the ide, /Leuciscus idus/, the pike, /Esox lucius/, and the pike-perch, /Lucioperca lucioperca/, on the degree of their motor activity, assessed on the rate of respiratory metabolism, was determined at different temperatures and oxygen concentrations. On the basis of the results obtained, a method of indirect assessment of the maximum possible values of the rate of respiratory metabolism and the maximum continuous swimming speed of fishes is proposed.

76-000584 Fursa, T. I. LARVAE OF /CHAMPSODON CAPENSIS/ (CHAMPSODONTIDAE, PISCES) FROM THE ARABIAN SEA. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (3): 444-447. 1974. SFA 21(2).

[AzCherNIRO, USSR] /C. capensis/ larvae up to 9.4 mm long are typified by the presence of a long filiform process in the upper corner of the operculum and one large melanophore on the ventral side in the postanal part of the body. Larvae 17.2 mm long are similar to the adult fish in the shape of the body and in the number of rays in the dorsal and anal fins; the outer margin of their preoperculum is serrate. C--From text.

76-000585 Giles, M. A.; Vanstone, W. E. ONTOGENETIC VARIATION IN THE MULTIPLE HEMOGLOBINS OF COHO SALMON (/ONCORHYNCHUS KISUTCH/) AND EFFECT OF ENVIRONMENTAL FACTORS ON THEIR EXPRESSION. J. Fish. Res. Board Can. 33 (5): 1144-1149. May 1976. In English with French summ. SFA 21(2).

[Dep. Biol. Sci., Sir George Williams Campus, Concordia Univ., Montreal, PQ H3G 1M8, Canada] Hemolyzates from the blood of coho salmon (/Oncorhynchus kisutch/) at various stages of development were subjected to micro-starch-gel electrophoresis. Three distinct electrophoretic patterns composed of different combinations of 18 hemoglobin tetramers were observed. Embryonic and yolk-sac alevins possessed 1 cathodic and 12 anodic components while fry retained only 3 of the 12 anodic polymorphs. During smoltification, 4 new cathodic components appeared and 2 of the anodic and the cathodic components of alevin hemolyzates reappeared. This latter pattern was retained until the fish spawned and died. Attempts to induce changes in the pattern of development of these hemoglobins by exposing fry and pre-smolts to extreme variations in dissolved oxygen, temperature, and salinity were completely unsuccessful.

76-000586 Goryunova, A. I. THE USE OF CYTOMETRIC ANALYSIS OF THE BLOOD TO STUDY INTRASPECIFIC DIFFERENTIATION IN THE COMMON WILD GOLDFISH [/CARASSIUS AURATUS GIBELIO/]. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (5): 792-799. 1974. SFA 21(2).

[Kazak Fish. Res. Inst., Alma-Ata, USSR] The populations of the common wild goldfish (/Carassius auratus gibelio/) in the drying out steppe lakes of Northern Kazakhstan are represented by unisexual and bisexual forms inhabiting the same body of water. In lakes where males of the bisexual form are not encountered, cytometric analysis of the blood helps in the detection of females of this form (morphologically indistinguishable from females of the unisexual forms). The erythrocytes of females of the unisexual form are larger; the ratio of the area of the erythrocytes in the unisexual and bisexual forms reaches 1.47.

76-000587 Gulidov, M. V. THE EFFECT OF DIFFERENT OXYGEN CONDITIONS DURING INCUBATION ON THE SURVIVAL AND SOME OF THE DEVELOPMENTAL CHARACTERISTICS OF THE "VERKHOVKA" [/LEUCASPIUS DELINEATUS/] IN THE EMBRYONIC PERIOD. J. Ichthyol. (Engl. Transl. Vopr. Iktiol.) 14 (3): 393-397. 1974. SFA 21(2).

[USSR Acad. Sci., Moscow, USSR] Four series of experiments were carried out on the incubation of the eggs of /Leucaspius delineatus/ from the stages of commencement of overgrowth of the yolk sac by the blastoderm-closure of the yolk plug to the hatching of embryos at different oxygen concentrations. The data obtained are examined in the light of the ecological developmental characteristics of /L. delineatus/ under natural conditions.

76-000588 Hoar, W. S. SMOLT TRANSFORMATION: EVOLUTION, BEHAVIOR, AND PHYSIOLOGY. J. Fish. Res. Board Can. 33 (5): 1234-1252. May 1976. In English with French summ. SFA 21(2).

[Dep. Zool., Univ. British Columbia, Vancouver, BC V6T 1W5, Canada] Literature concerned with the appearance of smolts (silvery color, streamlined body form), and their physiology (salinity relationships, endocrinology), and their behavior (territorial and schooling) is discussed in relation to key steps that may have been taken in the evolution of the parr-smolt transformation and seagoing behavior. In this discussion, it is assumed that Salmonidae evolved in fresh water, that the genus /Oncorhynchus/ originated in a large area of brackish water such as the Sea of Japan, and that schooling oncorhynchids (for

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example, /O. gorbuscha/ and /O. keta/) are the most specialized of the seagoing salmonids while species of char (/Salvelinus/) and trout (/Salmo/) are more primitive.

76-000589 Jinks, S. M. AN INVESTIGATION OF THE FACTORS INFLUENCING RADIOCESIUM CONCENTRATIONS OF FISH INHABITING NATURAL AQUATIC ECOSYSTEMS. Ph.D. dissertation, N.Y. Univ. 308p. 1975. From Diss. Abstr. Int. B Sci. Eng. 36(11), 1976. SFA 21(2).
In the Hudson River estuary, the distribution of radiocesium between suspended and dissolved phases in water was found to be a function of salinity. Desorption by salt water is identified as the major mechanism for transport of radiocesium from bottom sediment in the lower estuary, and half-times for removal by this mechanism are estimated to be 1.5-2.0 years. Radiocesium dissolved in water was the primary source to the fish in all ecosystems. Sediment inventories of $^{137}Cs$ constituted a secondary source which provided as much as 50 percent of the radiocesium in benthic feeding fish in the Hudson River. Dietary intake of $^{137}Cs$ is shown to be inversely related to the potassium concentration in the ambient water, and results in an inverse proportionality between the concentration factor in fish and the potassium concentrations in the different freshwater and estuarine ecosystems. Mean concentration factors ranged from about 30 (marine) to over 2000 (Sterling Lake). Concentrations of radiocesium in piscivores from all the freshwater systems were about two-fold higher than in prey species. In the marine environments, the majority of the intake of radiocesium by non-piscivorous fish resulted from the direct ingestion of salt water. Marine piscivores may take in three to six times more $^{137}Cs$ in their food. A predictive model for radiocesium accumulation by fish is developed and tested against observed concentrations in the freshwater and estuarine systems. --From abstr.

76-000590 Jones, B. J.; Pearson, W. D. VARIATIONS IN HEMATOCRIT VALUES OF SUCCESSIVE BLOOD SAMPLES FROM BLUEGILL. Trans. Am. Fish. Soc. 105 (2): 291-293. Mar. 1976. SFA 21(2).
[Okla. Coop. Fish. Res. Unit, Okla. State Univ., Stillwater 74074]
Microhematocrit values of four 100-ul samples of blood drawn successively from the severed peduncle of bluegills declinced 16 percent (range = 4-25 percent) from the first to the fourth tube. This significant decline is ascribed to the rapid passage of interstitial fluids into the blood stream of the hemorrhaging fish, and represents a source of variation which must be considered in establishing "normal" hematological values for fish.

76-000591 Karpenko, G. I. THE EFFECT OF SALINITY ON THE EGGS AND EMBRYOS OF THE "SHEMAYA" (/CHALCALBURNUS CHALCOIDES SCHISCHKOVI/). J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (6): 993-995. 1974. SFA 21(2).
[AzNIIRKh, Rostov-on-Don, USSR]

76-000592 Kiceniuk, J. W. SOME ASPECTS OF EXERCISE PHYSIOLOGY IN FISH. Ph.D. dissertation, Univ. British Columbia 1975. From Diss. Abstr. Int. B Sci. Eng. 36(12), 1976. SFA 21(2).
The limiting factors of swimming performance were studied in fish exercising in a water tunnel. The relationship between (10 min) critical velocity and body length determined in 10 species of freshwater teleosts is discussed with respect to the ratio of lateral red body musculature to total body weight. Electromyographic recording from red and white portions of the body musculature in four species of fish showed that red muscle fibers alone are active during steady

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swimming at sustained speeds. White muscle fibers are active only during bursts of violent swimming, such as during rapid acceleration and for a brief period preceeding fatigue. Thus red muscle fibers, generally accepted as having an aerobic metabolism, appear to be the major determinant of sustained swimming speed.

Most of the heart rate increase occurred in the first thirty seconds and heart rate did not change further after 3-15 minutes at a given swimming speed. Ventilation rate tended to increase initially and then decline, reaching a constant value after 15-30 minutes at a given swimming speed. Dorsal and ventral aortic blood pressure increased more slowly than heart rate, peaking after six minutes then declining to constant values after about 30 minutes. Blood pressure in the common cardinal vein was constant during exercise.

Oxygen consumption increased from a mean of 0.58 ml $kg^{-1}$ $min^{-1}$ at rest to a mean maximum of 4.34 ml $kg^{-1}$ $min^{-1}$. Under the same circumstances cardiac output increased from a mean of 17.6 ml $kg^{-1}$ $min^{-1}$ at rest to a mean maximum of 52.6 ml $kg^{-1}$ $min^{-1}$. The corresponding stroke volume was 0.46 ml $kg^{-1}$ $stroke^{-1}$ at rest and 1.03 mg $kg^{-1}$ $stroke^{-1}$. Arterial venous oxygen difference at rest was 3.29 volumes percent and increased to 8.3 volumes percent as a result of a decrease in venous saturation (to lower than 10 percent in some cases) during exercise.

Heart rate at rest was 31.75 $min^{-1}$ and increased during exercise by a mean of 1.33 times. Ventral aortic blood pressure rose from 38.8 Torr at rest to 61.7 Torr. The corresponding ventral aortic pulse pressure rose from 11.6 Torr at rest to 26 Torr. Dorsal aortic mean pressure at rest was 31 Torr and increased to 37 Torr with exercise, accompanied by an increase in pulse pressure from 5.8 Torr at rest to 10 Torr. Ventilatory volume at rest was 211.4 ml $kg^{-1}$ $min^{-1}$ and increased to about 1700 ml $kg^{-1}$ $min^{-1}$ at maximal sustained swimming speed. The capacity rate ratio of oxygen exchange between water and blood increased from 0.6 at rest to 1.8 during exercise. Arterial blood of resting trout was 97 percent saturated with oxygen and percent saturation did not change with exercise. Blood lactate at rest and at swimming speeds as high as 93 percent of critical velocity was 0.5 uM/ml. One minute after fatigue the blood lactate level had increased about five fold and continued to increase, reaching a maximum value (6-10 uM/ml) 2 to 2.5 hours after fatigue. --From abstr.

76-000593 Kirilenko, N. S.; Mel'nikov, G. B.; Grinberg, L. R.; Nazimirova, N. I. THE DIGESTIBILITY OF THE CRUDE PROTEIN AND NEUTRAL FAT OF SOME MICROALGAE BY /TILAPIA MOSSAMBICA/ PETERS. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (1): 151-155. 1975. SFA 21(2).

[Dnepropetrovsk State Univ., Dnepropetrovsk, USSR] Digestibility of crude protein from unicellular algae (/Chorella/ blue-green algae and mixtures of them) by /Tilapia mossambica/ is lower than the digestibility of crude protein from /Daphnia/. Of the unicellular algae investigated, the crude protein in the blue-green algae is most accessible to the digestive enzymes of /Tilapia mossambica/. The raw protein of a mixutre of /Chlorella/ and blue-green algae and /Chlorella/ is slightly less accessible. Age differences in the digestibility by /Tilapia/ of crude protein from the unicellular algae investigated, are insignificant. The digestibility of crude protein of the blue-green algae is 7.38 percent higher in fish of the older age group than in fish of the younger one. The digestibility of neutral fat from the unicellular algae investigated is, when compared with the digestibility of neutral fat from /Daphnia/, lower in fish of the younger age group and higher in those of the older age group. Neutral fat from blue-green algae is more easily accessible to the /Tilapia/ organism than neutral fat from /Chlorella/ and a mixture of /Chlorella/ and blue-green algae; the digestibility of neutral fat

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from the unicellular algae investigated is higher in the intestines of fish of the older age group than in the younger age group. --From concl.

76-000594 Koenst, W. M.; Smith, L. L., Jr. THERMAL REQUIREMENTS OF THE EARLY LIFE HISTORY STAGES OF WALLEYE, /STIZOSTEDION VITREUM VITREUM/, AND SAUGER, /STIZOSTEDION CANADENSE/. J. Fish. Res. Board Can. 33 (5): 1130-1138. May. 1976. In English with French summ. SFA 21(2).
[Dep. Entomol., Fish. Wildl., Univ. Minn., St. Paul 55108] Walleye (/Stizostedion vitreum vitreum/) and sauger (/Stizostedion canadense/) eggs were exposed to temperatures ranging from 6 to 21 C to determine temperature effects on fertilization, incubation, and fry survival. Optimum fertilization temperatures were 6-12 C for walleye and 9 C for sauger. Optimum incubation temperatures were 9-15 C for both walleye and sauger. A sharp drop or rise in temperature had no great effect on walleye fry and juvenile survival. Optimum temperature for juvenile walleye and sauger growth was 22 C. When acclimated at 8-26 C, 96-h upper lethal temperatures for walleye juveniles were 27.0-31.6 C, with the lower acclimation temperatures producing the lower upper lethal limits and intermediate acclimation producing intermediate upper lethal limits in order as acclimation temperatures increased. When acclimated at 10-26 C, the 96-h upper lethal temperatures for sauger juveniles was 26.6-30.4 C, in order as with the walleye.

76-000595 Krayushkina, L. S.; Dyubin, V. P. THE REACTION OF JUVENILE STURGEON TO ALTERATION OF ENVIRONMENTAL SALINITY. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (6): 971-977. 1974. SFA 21(2).
[Leningrad Univ., Leningrad, USSR] The salinity tolerance of juvenile Russian sturgeon (/Acipenser guldenstadti/), sevryuga (/Acipenser stellatus/) and beluga (/Huso huso/) in the early stages of otogeny was experimentally determined. The adaptation of juveniles of the same age but of different sizes, and also of the same size but of different age to a hypertonic environment was determined by measurement of the osmolarity of the blood serum. The chloride-secreting cells of the gills, which play a part in osmotic regulation, were histologically investigated at the same time.

76-000596 Lebedeva, N. Ye.; Burlakov, A. B. VARIATION OF THE COMPOSITION OF WATER SOLUBLE PROTEINS IN THE SKIN AND MUCUS OF THE MINNOW /PHOXINUS PHOXINUS/ UNDER THE INFLUENCE OF A LONG PERIOD IN THE LABORATORY. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (1): 163-166. 1975. SFA 21(2).
[Dep. Ichthyol., Moscow State Univ., Moscow, USSR]

76-000597 Lipskaya, N. Ya. METABOLIC RATES IN THE YOUNG OF SOME TROPICAL FISH SPECIES. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (6): 934-943. 1974. SFA 21(2).
[VNIRO, Moscow, USSR] The respiratory rate of juveniles of some tropical fish species of different ecological groups was investigated. A quantitative relationship is shown to exist between the rate of oxygen consumption and the body weight of the fish. Different metabolic levels were determined in the young of different ecological groups.

76-000598 Long, W. L.; Ballard, W. W. NORMAL EMBRYONIC STAGES OF THE WHITE SUCKER, /CATOSTOMUS COMMERSONI/. Copeia 1976 (2): 342-351. May 1976. SFA 21(2).

[Biol. Dep., West. Md. Coll., Westminster 21157] The embryonic period of life of this cypriniform teleost is divided, as required for experimentation, into 26 stages, from fertilization to exhaustion of yolk supply. Diagnostic structural characteristics are cited for each stage. The rate of development is indicated at several constant temperatures.

76-000599 Magomedov, S. K.; Chernyshev, V. I.; Shekhanova, I. A. A COMPARATIVE STUDY OF SOME OF THE PHYSICO-CHEMICAL MECHANISMS INVOLVED IN THE ADAPTATION OF FISHES TO DIFFERENT SALINITIES. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (3): 426-431. 1974. SFA 21(2).

[VNIRO, Moscow, USSR] It has been shown by comparative study of the Physico-chemical properties of lipids in different species of aquatic orgamisms that euryhaline forms possess large reserves of lipid antioxidants. The authors regard this as one of the factors enabling the organism to adapt itself to fluctuation in the salinity of the environment.

76-000600 Maslennikova, N. V. THE AMINO ACID COMPOSITION OF SOME FISH TISSUES. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (6): 943-954. 1974. SFA 21(2).

[VNIRO, Moscow, USSR] An analysis was performed of amino acid composition in the proteins of the muscles, liver and sexual products of various fish species, as well as free amino acids in these organs and tissues.

76-000601 McCormick, J. H.; Kleiner, C. F. GROWTH AND SURVIVAL OF YOUNG-OF-THE-YEAR EMERALD SHINERS (/NOTROPIS ATHERINOIDES/) AT DIFFERENT TEMPERATURES. J. Fish. Res. Board Can. 33 (4,1): 839-842. Apr. 1976. In English with French summ. SFA 21(2).

[U.S. EPA, Environ. Res. Unit., Duluth, MN 55804] Young-of-the-year emerald shiners (/Notropis atherinoides/) were exposed to mean constant temperatures of 6.9, 11.9, 16.0, 19.8, 24.0, 26.9, 28.9, 31.0, 32.8, 34.9, and 36.7 C for 6 wk. Maximum rates of growth and net biomass gain occurred at 28.9 C, but these rates were not statistically greater (P greater than 0.05) than those at 26.9 and 24.0 C. Death rates were low at test temperatures up to 32.8 C but high at 34.9 C and above. The upper incipient 7-day TL50 was estimated to be 35.2. The 1-day TL50 of fish taken from the natural habitat, where peak daily temperatures ranged between 20 and 25 C during the preceeding few days, was 32.6 C. Natural production of this important forage species would probably be best where temperatures are at least 19 C but not above 29 C for extended periods.

76-000602 Muravskaya, Z. A.; Verbitskaya, V. F. DETERMINATION OF THE RATE OF NITROGEN EXCRETION IN SOME FASTING SEA FISHES. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (2): 298-301. 1974. SFA 21(2).

[Inst. Biol. South. Seas, Ukr. Acad. Sci., Sevastopol, USSR]

76-000603 Muromtseva, A. V. BLOOD PROTEIN COMPOSITION IN THE ARAL BREAM (/ABRAMIS BRAMA ORIENTALIS/). J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (4): 607-610. 1974. SFA 21(2).
[Astrakhan Fish Ind. Fish. Tech. Inst., Astrakhan, USSR]

76-000604 Natochin, Yu. V.; Krayushkina, L. S.; Maslova, M. N.; Sokolova, M. M.; Bakhteyeva, V. T.; Lavrova, Ye. A. ENZYME ACTIVITY IN GILLS AND KIDNEYS AND ENDOCRINE FACTORS IN THE REGULATION OF ION EXCHANGE IN DOWNSTREAM MIGRATING AND SPAWNING SOCKEYE SALMON, /ONCORHYNCHUS NERKA/. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (1): 115-124. 1975. SFA 21(2).
[USSR Acad. Sci., Leningrad, USSR] The nature of magnesium secretion by the kidney can serve as a test for the assessment of the functional state of ion-regulating systems. Magnesium secretion is observed in the migratory sockeye, /Oncorhynchus nerka/, but is gradually depleted in fish prior to spawning. After injection of MgCl(2) solution in the migratory sockeye the activity of Na, K-ATPases increases in the kidney and granular formation becomes more pronounced in the Stannius bodies. The influence of different hormones on the secretion of magnesium by the kidney was investigated; humoral factors stimulating magnesium secretion were found in the blood of migratory fish. A hypothesis is advanced that the preparation of fish for migration is linked with a change in the functional state of the kidney and branchial cells; the increase in them of enzyme activity does not precede, but is observed at the moment of intensification in their cells of ion transport. The activation of the transport of magnesium and sodium ions is dependent on the entry into the blood of humoral factors in response to the increase in the concentration of these ions in the blood of the fish.

76-000605 Negonovskaya, I. T.; Rudenko, G. P. THE OXYGEN THRESHOLD AND CHARACTERISTICS OF THE RESPIRATORY METABOLISM OF JUVENILE HERBIVOROUS FISHES--THE GRASS CARP (/CTENOPHARYNGODON IDELLA/) AND THE BIGHEAD (/ARISTICHTHYS NOBILIS/). J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (6): 965-970. 1974. SFA 21(2).
[GosNIORKh, Leningrad, USSR] Sublethal and threshold oxygen values are established for juvenile grass carp (/Ctenopharyngodon idella/) and bighead (/Aristichthys nobilis/) at an age of 1-1.5 months. Respiratory metabolism was found to be considerably more labile in herbivorous fishes than in other species. Procedural aspects of the investigation of oxygen thresholds in fishes are discussed.

76-000606 Perry, J. W. A COMPARISON OF THE BLOOD RESPIRATORY PROPERTIES OF THE GAR AND BOWFIN (/LEPISOSTEUS/, /AMIA/). Proc. W. Va. Acad. Sci. 48 (1): 28. 1976. Abstract only. SFA 21(2).
[Dep. Sci. Math., W. Va. North. Comm. Coll., Wheeling 26003] The purpose of this work was to compare the basic blood respiratory parameters of two North American air breathing fish; the bowfin, /Amia calva/ L. and the spotted gar, /Lepisosteus oculatus/ W. acclimated at 1k and 25 C.
Blood samples were taken from the first efferent branchial artery by a rapid sampling procedure. Aliquots were then analyzed for RBC number, Hct, Hb, pH, Po(2), P(CO2), oxygen capacity and oxygen dissociation properties using standard hematolcgical techniques.
Mean RBC counts, Hct, Hb concentrations and oxygen capacities were significantly higher for the spotted gar than for the bowfin. These two species displayed similar blood pH values and carbon dioxide tensions but the gar had slightly higher blood oxygen tensions.
Analysis of O(2)-Hb dissociation curves revealed similar features for both species. No significant Root effect was observed but an

76-000606 CONTINUED
obvious Bohr effect was detected. Temperature had a conspicuous effect on O(2)-Hb affinity; the P(50) values increased nearly three fold as blood temperature was elevated from 15 to 25 C.
The adaptive significance of these blood respiratory data will be discussed in relation to the general respiratory behavior and habitat characteristics of these two fish species.

76-000607 Sbikin, Yu. N. CHARACTERISTICS OF THE VISION OF TEN SPECIES OF FISH FROM THE CUBAN SHELF. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (1): 142-146. 1975. SFA 21(2).
[IEMEZh, USSR Acad. Sci., Moscow, USSR] The species of fish investigated have well-developed vision with high functional characteristics, and in them, as also in all other fishes, these characteristics reflect the ecological peculiarities of each species. The strongest optomotor reaction is observed in motile fishes (barracuda, small coral fishes) while in demersal fishes it is considerably weaker. The critical flicker fusion frequency is highest for fast-swimming fishes and for fishes feeding on very mobile food (mainly for predators). Characteristic of these fishes is also the greatest sensitivity of the eyes to light which enables them to hunt successfully at dusk. During the transition from light adaptation to darkness adaptation, the sensitivity of the eye to light increases greatly in all the fishes investigated.
The characteristics of spectral sensitivity are the same in all of the fishes investigated by us; this is explained by the similarity in the spectral composition of light in their habitats. Fishes living under different light conditions, for instance, freshwater and deepsea species, have a different spectral sensitivity. The presence in the fishes investigated of the Purkinje effect makes it possible to assume that they have color vision. --From concl.

76-000608 Shubin, P. N.; Kachmarchik, E. V. ELECTROPHORETIC STUDIES OF HEMOGLOBIN IN TWO AGE FORMS OF THE PECHORA SALMON (/SALMO SALAR/). J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (6): 995-998. 1974. SFA 21(2).
[USSR Acad. Sci., Syktyvkar, USSR]

76-000609 Smirnova, L. I.; Govorova, M. F. OSMOTIC AND CHEMICAL RESISTANCE OF FISH ERYTHROCYTES. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol). 14 (6): 959-965. 1974. SFA 21(2).
[IEMEZh, USSR Acad. Sci., Moscow, USSR] It is established that the acid resistance of fish erythrocytes, like the osmotic resistance, varies from season to season. In the middle of the summer acid erythrograms are shifted to the left, toward erythrocytes of low resistance, while in the autumn and spring the precentage of erythrocytes of high resistance increases. Acid erythrograms possess appreciable individual fluctuations, the amplitude of which is greater in the first half of the summer than in the second. The reduction of acid and osmotic resistance in the summer is evidently connected with an increase in metabolism and in the water content of the blood and with loss of strength in the membrane of old, less elastic erythrocytes.

76-000610 Somkina, N. V. PHYSIOLOGICAL CONSIDERATIONS AFFECTING THE TIME OF RELEASE OF JUVENILE STURGEON (/ACIPENSER GULDENSTADTI/ BRANDT). J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (4): 561-566. 1974. SFA 21(2).

[AzNIIRKh, Raston on Don, USSR] A number of physiological and biochemical indicators of physiological condition of juvenile sturgeon in the early stages of ontogeny under the influence of different salinities was made. Salinity affects growth rate, the respiratory function of the blood, the dynamics of free amino acids and the ratio of the protein fractions in the blood serum of juvenile sturgeon of different ages. Optimum salinity conditions and the adaptive capabilities of juvenile sturgeon of different ages were determined.

76-000611 Stanley, J. G. FEMALE HOMOGAMETY IN GRASS CARP (/CTENOPHARYNGODON IDELLA/) DETERMINED BY GYNOGENESIS. J. Fish. Res. Board Can. 33 (6): 1372-1374. June 1976. In English with French summ. SFA 21(2).

[U.S. FWS, Fish Farming Exp. Stn., Stuttgart, AR 72160] Gynogenesis occurred in eggs of grass carp (/Ctenopharyngodon idella/) treated with X-irradiated milt from goldfish (/Carassius auratus/). Gynogenetic offspring were females, which indicated functional female homogamety in grass carp. Five of these gynogenetic fish were used as an egg source for a second generation of artificially gynogenetic fish. The percentage yield in this second generation was about the same as in the first, which suggests that the tendency to become diploid is not strongly heritable.

76-000612 Talikina, M. G. OOGENESIS AND SEXUAL CYCLE OF THE BLACK SEA TURBOT [/SCOPHTHALMUS MAEOTICUS MAEOTICUS/]. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (3): 377-384. 1974. SFA 21(2).

[Azcher NIRO, Kerch, USSR] Four development periods and seven development stages have been distinguished in the egg cells of the Black Sea turbot [/Scophthalmus maeoticus maeoticus/] by the method of histological analysis in the course of oogenesis. Polysaccharides are shown to be present in the oocyte membranes, the peripheral portion of the cytoplasm and the cortical vacuoles. Lipid inclusions are localized in the perinuclear part of the oocyte and merge during maturation into a single lipid drop. Six stages of ovarian development on which the description of the maturity scale of females is based are distinguished in the annual sexual cycle.

76-000613 Trusov, V. Z. MATURATION OF THE GONADS IN FEMALE SEVRYUGA /ACIPENSER STELLATUS/ DURING ITS LIFE IN THE OCEAN. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (1): 61-72. 1975. SFA 21(2).

[GosNIORKh, Leningrad, USSR] The results of histophysiological research into the gonads of the females of the sevryuga, /Acipenser stellatus/, during its life in the ocean are presented. It is demonstrated that the gonads reach stage IV of maturity during the oceanphase of its life cycle. The phases of maturation of the ovaries are established and a more detailed scale of maturity of gonads is submitted on the basis of visual and histological anaylsis.

76-000614 Volodin, V. M.; Mezhnin, F. I.; Kuz'mina, V. V. AN EXPERIMENTAL STUDY OF EGG RESORPTION IN THE BREAM [/ABRAMIS BRAMA/]. J. Ichthyol. (Engl. Transl. Ikhtiol.) 14 (2): 219-231. 1974. SFA 21(2).

[Inst. Biol. Inland Waters, USSR Acad. Sci., Borok, Yaroslavl Prov., USSR] A description is given of five stages in the resorption of practically mature eggs of female bream [/Abramis brama/] in experimental ponds; data are given on the state of the interrenal and chromaffin tissues, on glycogen content in the liver, muscles and gonads, the amount of fat in the muscles and ovaries and alteration in the leukocyte formula of the blood at the time of egg resorption. Consideration is given to the duration of resorption and to its effect on the development of the next generation of oocytes.

76-000615 Yarzhombek, A. A.; Klyashtorin, L. B. THE RELATIONSHIP BETWEEN STANDARD METABOLISM AND RESTING METABOLISM IN FISHES. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (3): 439-443. 1974. SFA 21(2).

[VNIRO, Moscow, USSR] An investigation was made of two approaches to the indirect evaluation of metabolic rate in fishes in the absence of muscular work. The first approach, the extrapolation of data on oxygen consumption and different swimming speeds to the zero velocity point, was found to be extremely laborious and relatively ineffective. The second approach, the extrapolation of data on oxygen consumption at different intensities of spontaneous and induced activity, was found to be more acceptable. In experiments conducted on striped bass fingerlings a clear relationship was established between oxygen consumption and motor activity. The authors propose their own modification of a respirometer chamber equipped with a membrane oxygen electrode that can be used both to determine standard metabolism while simultaneously recording and evaluating the level of motor activity and to determine the level of total metabolism at an assigned motor loading.

76-000616 Zhitenev, A. N.; Kalinin, D. S.; Abayev, Yu. I. THE STATE OF THE GONADS OF THE STRIPED MULLET [/MUGIL CEPHALUS/] AND THE SHARPNOSE MULLET [/M. SALIENS/] LEAVING ESTUARIES TO SPAWN, AND THEIR REACTION TO A PITUITARY INJECTION. J. Ichthycl. (Engl. Transl. Vopr. Ikhtiol.) 14 (2): 232-239. 1974. SFA 21(2).

[VNIIPRKh, Krasnodar, USSR] The histologic state of the gonads of the striped mullet [/Mugil cephalus/] and the sharpnose mullet [/M. saliens/] and the changes occurring as a result of pituitary injections have beens studied at the Kiziltash mullet-rearing establishment. Oocytes in pituitary stage IV are divided into three stanzas by their morpho-physiological state. The injection of spawners leads to resorption of the oocytes when the gonads are in development stages IVa and IVb and to completion of maturation when the gonads are in stage IVc.

## GENETICS, VARIATION STUDIES AND HYBRIDIZATION

76-000617 Bailey, G. S.; Tsuyuki, H.; Wilson, A. C. THE NUMBER OF GENES FOR LACTATE DEHYDROGENASE IN SALMONID FISHES. J. Fish. Res. Board Can. 33 (4,1): 760-767. Apr. 1976. In English with French summ. SFA 21(2).

[Biochem. Dep., Univ. Otago, Dunedin, New Zealand] Rainbow trout (/Salmo gairdneri/) that show polymorphism at the /ldhH/ alpha locus for liver lactate dehydrogenase (LDH) (L-lactate: NAD oxidoreductase,

76-000617 CONTINUED
EC 1.1.1.27) have been examined electrophoretically and immunologically. These results show that the /ldhH/ alpha locus is active in two possible allelic forms, /ldhH/ alpha-A and /ldhH/ alpha-B, in many tissues such as heart, liver, kidney, eye, red blood cell, brain, and pyloric caeca. Quantitative microcomplement fixation tests support the contention that H alpha-A and H alpha-B subunits are allelic variants. These results, combined with electrophoretic studies on brook trout (/Salvelinus fontinalis/) polymorphic at the /ldhH/ beta locus, lead us to conclude that all isozymes for LDH in salmonid fishes can be accounted for by the activity of four, and possibly five structural loci: /ldhH/ alpha, /LdhH/ beta, /ldhC/, /LdhM/ alpha, and possibly /ldhM/ beta. These results are in contrast to previous suggestions that the multiple lactate dehydrogenases of trout are encoded by 8 or 10 structural genes per haploid genome.

76-000618 El-Ibiary, H. M.; Andrews, J. W.; Joyce, J. A.; Page, J. W.; DeLoach, H. L. SOURCES OF VARIATIONS IN BODY SIZE TRAITS, DRESS-OUT WEIGHT, AND LIPID CONTENT AND THEIR CORRELATIONS IN CHANNEL CATFISH, /ICTALURUS PUNCTATUS/. Trans. Am. Fish. Soc. 105 (2): 267-272. Mar. 1976. SFA 21(2).

[Univ. Ga. Agric. Exp. Stn., Dep. Entomol. Fish., Savannah 31406] Data on body weight, five body measurements, dress-out weight, and lipid content were collected from 56-week old channel catfish, /Ictalurus punctatus/, which belonged to 18 full-sib families. Analyses of variance showed that: (1) all sex differences, except that in dressing percentage and lipid content, were significant (P less than 0.01); (2) the sex component of variance in percent of total variance ranged from 0.0 percent for lipid content to 34.7 percent for interorbital width; (3) all family differences were significant (P less than 0.01), while those between replicate tanks were insignificant (P greater than 0.05); (4) differences between families or individual fish contributed most to total variance while those between tanks and family X tank interactions contributed least; (5) in all characters observed, the family component of variance ranged from 12.6 percent (dress-out percent) to 49.2 percent (head length) of total variance.

Dress-out weight was positively and highly correlated with body weight, body measurements, or head weight (r = 0.89 or more). The correlations between percent dress-out and these characters were medium or small (r = 0.25-0.54). With the exception of percent head weight, all other characters had medium or small correlations with lipid content (r = 0.15-0.49). Percent head weight was negatively but moderately correlated with dress-out weight, dress-out percentage, and lipid content.

76-000619 Gorman, G. C.; Kim, Y. J.; Rubinoff, R. GENETIC RELATIONSHIPS OF THREE SPECIES OF /BATHYGOBIUS/ FROM THE ATLANTIC AND PACIFIC SIDES OF PANAMA. Copeia 1976 (2): 361-364. May 1976. SFA 21(2).

[Dep. Biol., Univ. Calif., Los Angeles 90024] Electrophoretic study of 26 gene loci was carried out on /Bathygobius soporator/ from the Atlantic side of Panama, and /B. ramosus/ and /B. andrei/ from the Pacific side of Panama. The most closely related pair is /B. soporator/ and /B. andrei/. The predicted divergence time is about 2.5 million years, which is in accord with geological evidence on the rise of the Panama land bridge. /B. ramosus/ is the distant member of the trio, about equidistant from the other pair.

76-000620 Kincaid, H. L. EFFECTS OF INBREEDING ON RAINBOW TROUT POPULATIONS. Trans. Am. Fish. Soc. 105 (2): 273-280. Mar. 1976. SFA 21(2).

[U.S. FWS, Fish Genet. Lab., Beulah, WY 82712] An approach for measuring inbreeding depression on the basis of differences between inbred and outbred half-sib family groups is described. Using this method, estimates of inbreeding depression in populations of rainbow trout (/Salmo gairdneri/) following one generation of brother-sister mating was calculated for three production traits--percent egg hatchability, percent fry survival from swim-up to 150 days, and weight at 150 days. The inbreeding depression estimates obtained from male and female half-sib families were 1.7 and 4.4 percent for percent egg hatchability, 22.2 and 16.1 percent for percent fry survival, and 12.0 and 9.8 percent for weight at 150 days, respectively. Estimates for fry survival and weight at 150 days were significant at P less than 0.01 while egg hatchability estimates were nonsignificant. Following one generation of full-sib mating, the calculated effect of inbreeding on the number of live fish and total weight of fish at 150 days of age showed a reduction of 16.1 and 24.4 percent in female families and 22.1 and 31.4 percent in male families, respectively. The difference between inbreeding depression estimates derived from male and female half-sib groups provide a measure of the maternal influence.

Generalized trends of increasing depression with increasing levels of inbreeding from F = 0.125 to F = 0.50 were significant for weight at all ages from 77 to 150 days, but were nonsignificant for percent hatchability or percent fry survival. Inbreeding depression estimates for weight are considered to be minimum estimates because higher mortality rates in the inbred families resulted in lower fish density during the rearing period and, therefore, compensatory growth which reduced the weight difference between inbred and outbred families.

76-000621 Lapin, Yu. Ye. VARIABILITY IN THE NUMBER OF VERTEBRAE AND LARVAL MYOMERES IN THE WHITE SEA HERRING (/CLUPEA HARENGUS PALLASI NATIO MARIS-ALBI/) IN CONNECTION WITH ITS ECOLOGY. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (4): 466-476. 1974. SFA 21(2).

[IEMEZh, USSR Acad. Sci., Moscow, USSR] It is demonstrated that the number of larval myomeres is similar in herring from Kandalaksha Bay and in herring from the North Atlantic, and that larvae from Onega Bay do not differ from Pacific herring larvae from the Sea of Okhotsk. It is concluded that the White Sea herring population is heterogeneous and incorporates features of similarity to both subspecies--to Atlantic herring with more vertebrae and to Pacific herring with fewer vertebrae. The great variability of the progeny of the White Sea herring with respect to the number of vertebrae is treated as a consequence of the different ecology of the parental stocks (feeding, maturation and spawning), as well as of different conditions of egg incubation (mainly temperature and salinity).

76-000622 LeGrande, W. H.; Fitzsimons, J. M. KARYOLOGY OF THE MULLETS /MUGIL CUREMA/ AND /M. CEPHALUS/ (PERCIFORMES: MUGILIDAE) FROM LOUISIANA. Copeia 1976 (2): 388-391. May 1976. SFA 21(2).

[Mus. Zool., Ohio State Univ., Columbus 43210]

76-000623 Makeyeva, A. P.; Verigin, B. V. HYBRIDIZATION OF THE POND CARP [/CYPRINUS CARPIO/] WITH THE GRASS CARP [/CTENOPHARYNGODON IDELLA/]. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (2): 254-259. 1974. SFA 21(2).

[Dep. Ichthyol., Moscow Univ., Moscow, USSR] The survival rate of the hybrid is low in repeated crossings of the pond carp [/Cyprinus carpio/] with the grass carp [/Ctenopharyngodon idella/]. Most of the hybrids perish due to various abnormalities, mainly of the gill and jaw apparatus. The underyearlings reared deviate considerably toward the maternal side, the pond carp.

76-000624 Makeyeva, A. P. THE PHENOMENON OF HYBRID GYNOGENESIS IN FISHES. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (1): 72-81. 1975. SFA 21(2).

[Dep. Ichthyol., Moscow State Univ., Moscow, USSR] Hybridization of bighead carp (female) with the pond carp (male) produced hatched embryos (0.004 percent) externally indistinguishable from the mother silver carp. They were assumed to be of gynogenetic origin. The size of the nuclei in the fin fold of the embryo was similar to that in the mother. The isozyme spectrum of these embryos, although close to that of the mother, nevertheless differs from it. These fish could therefore also be hybrid in origin. The bulk of the embryos obtained from crossing bighead carp with carp are hybrids in whose development paternal influence is traced. All hybrids are deformed and perish in the embryonic stage. Analysis of their karyotype at the blastular stage showed an intermediate number of chromosomes by comparison with the parents.

76-000625 Morgan, R. P. II; Ulanowicz, N. I. THE FREQUENCY OF MUSCLE PROTEIN POLYMORPHISM IN /MENIDIA MENIDIA/ (ATHERINIDAE) ALONG THE ATLANTIC COAST. Copeia 1976 (2): 356-360. May 1976. SFA 21(2).

[Chesapeake Biol. Lab., Univ. Md., Solomons 20688] Electrophoretic separation of the soluble muscle proteins from the Atlantic silverside (/Menidia menidia/ L.) revealed three phenotypes (Mu /AA/, /AB/ and /BB/) postulated to be genetically controlled by two codominant alleles, independent of the sex and size of the fish. The frequency, Mu-A, of the fastest migrating phenotype differed among samples collected from 11 localities along the Atlantic coast. Phenotypes of the muscle proteins are related to body depth of the /Menidia/.

76-000626 Ney, J. J.; Smith, L. L., Jr. SERUM PROTEIN VARIABILITY IN GEOGRAPHICALLY-DEFINED BLUEGILL (/LEPOMIS MACROCHIRUS/) POPULATIONS. Trans. Am. Fish. Soc. 105 (2): 281-290. Mar. 1976. SFA 21(2).

[Dep. Fish. Wildl. Sci., VPI & SU, Blacksburg, VA 24061] Blood serum proteins of mature bluegills, /Lepomis macrochirus/ Rafinesque, collected from two stations in each of two east-central Minnesota lakes were analyzed by polyacrylamide disc gel electrophoresis. Transferrin and prealbumin proteins were found to be polymorphic. The transferrin polymorphism occurred only in Forest Lake fish and was extremely rare. Analogy with other fish species suggests that the bluegill transferrin system is controlled by two codominant alleles, one of which may be lethal in the homozygous state. Three prealbumin phenotypes consisting of single or double bands were observed at all stations. Phenotypic distribution did not conform to the expected Hardy-Weinberg proportion for a system of two codominant alleles at three of four stations and was independent of factors of size, age, season, and method of capture at all stations. Phenotype varied significantly with sex at one Forest Lake station. Distribution of prealbumin phenotypes in female bluegills displayed a significant

76-000626 CONTINUED
difference between Forest Lake stations or between lakes. Big Carnelian Lake stations but not between Big Electrophoretic analysis has the potential to clarify the adequacy of the geographic isolation concept in bluegill population definition.

76-000627 Otto, R. S. ISOENZYME SYSTEMS OF THE STRIPED BASS (/MORONE SAXATILIS/) AND CONGENERIC PERCICHTHYID FISHES. Ph.D. dissertation, Univ. Maine 71p. 1975. From Diss. Abstr. Int. B Sci. Eng. 36(10), 1976. SFA 21(2).

An electrophoretic study of North American /Morone/ species was undertaken to examine the genetic status of striped bass populations and elucidate evolutionary relationships. Collections of striped bass from the Maine Coast, Hudson River, James River, York River, Rappahannock River and Potomac River were surveyed for variation in 28 enzyme loci. California striped bass were surveyed at 18 enzyme loci. Examination of 23 loci in white perch (/M. americana/), yellow bass (/M. mississippiensis/) and white bass (/M. crysops/) was limited to one collection of each species. Variation was found in five loci of striped bass and three loci were polymorphic (five percent criterion). No genetic variation was observed in other species. Gene frequencies of Hudson River striped bass were significantly different from those of the aggregate Chesapeake Bay sample. Gene frequencies in each Atlantic Coast collection differed from those of other collections at one or more loci. California striped bass showed no variation. Measurement of genetic distance (Nei, 1972) showed that differences between striped bass populations are probably very small. Several hypotheses of population differentiation are examined. Interspecific differences were observed for six loci. White perch and yellow bass samples were identical and both differed from striped bass at four loci and from white bass at five loci. White bass and striped bass differed at three loci. These differences presumably reflect affinities within the genus. Genetic diversity, measured as mean heterozygosity, is very low in striped bass and probably other /Morone/ species. Atlantic Coast striped bass have a mean heterozygosity of 0.95 percent, which is the lowest reported for a composite sampling of a teleost species.

76-000628 Poltorykhina, A. N. MORPHOLOGICAL CHARACTERISTICS AND VARIABILITY OF THE SIBERIAN LAMPREY [/LAMPETRA JAPONICA KESSLERI/] FROM THE UPPER IRTYSH BASIN. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (2): 192-202. 1974. SFA 21(2).

[Ust'-Kamenogorsk Pedagog. Inst., USSR] New data are given on the morphology of the Siberian lamprey [/Lampetra japonica kessleri/] from the Upper Irtysh basin. The meristic characters (shape and number of horny teeth in the buccal funnel, number of trunk myomeres) and morphological characters of 300 sexually mature lampreys were investigated. Some peculiarities are established in the structure of the dental apparatus and in the variation of exterior characters. It is noted that there is clearly expressed sexual dimorphism and weakly manifested size-related and ecological variability.

76-000629 Vyshegorodtsev, A. A. THE MORPHOLOGICAL CHARACTERISTICS OF THE SIBERIAN CISCO /COREGONUS ALBULA SARDINELLA/ (VAL.) FROM THE YURIBEY RIVER (GYDA BAY BASIN). J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (1): 27-36. 1975. SFA 21(2).

[Dep. Ichthyol. Hydrobiol., Tomsk State Univ., Tomsk, USSR] The reproductive and size-age variability of the Siberian cisco /Coregonus albula sardinella/ (Val.) from the Yuribey River of the Gyda Bay basin was analyzed. The special features and the nature of the variability of three cisco populations from different areas in the Gyda Bay basin

76-000629 CONTINUED
are examined. Considerable similarity between populations has been discovered in the majority of the meristic and morphological characters. A comparison of the cisco from the Yuribey River with the cisco from eight Siberian populations demonstrates not only their considerable variability, but also the great morphological similarity of the separate populations.

76-000630 Yermokhin, V. Ya. VARIATION IN THE NUMBER OF VERTEBRAE IN THE SPAWNING POPULATION OF THE BENTHOPHAGIC WHITEFISH WITH FEW GILL RAKERS, /COREGONUS LAVARETUS/, OF THE KOLA PENINSULA. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (6): 824-836. 1974. SFA 21(2).
[IEMEZh, USSR Acad. Sci., Moscow, USSR] Spawning runs of whitefish from Lake Chun were sampled for vertebrae counts in 1968, 1969, and 1970. The specimens represented year-classes spawned in 1963, 1964 and 1965. The average number of vertebrae increased with each successive year-class. This phenomenon is attributed to climatic factors influencing water temperatures during incubation. Within each year-class, fish with fewer vertebrae exhibited more rapid growth, an earlier age of maturity and a shorter life span than fish with higher vertebral numbers.

76-000631 Zhukov, V. V. THE ANTIGENIC LINKS OF SOME SPECIES OF THE GENUS /COREGONUS/. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (4): 476-483. 1974. SFA 21(2).
[Urals Sci. Cent., USSR Acad. Sci., USSR] The use of heteroimmune sera in the analysis of erythrocytic antigens has enabled us to establish the nature of the links between some coregonids. Antigenic relations have been interpreted in percentages, by the method of Boyden, and in "immunological distances", by the method of Mainardi. The closer antigenic links of /C. tugun/, /C. lavaretus pidschian/ and /C. peled/ and the weakened links in /C. nasus/ have been confirmed by absorption experiments and in analysis of their serum proteins with anti-/C. tugun/ serum. The scope for the use of antigenic links to clarify phylogeny within the genus is discussed.

## BEHAVIOR

76-000632 Able, K. W. CLEANING BEHAVIOR IN THE CYPRINODONTID FISHES: /FUNDULUS MAJALIS/, /CYPRINODON VARIEGATUS/, AND /LUCANIA PARVA/. Chesapeake Sci. 17 (1): 35-39. Mar. 1976. SFA 21(2).
[Biol. Dep., McGill Univ., P.O. Box 6070, Station A, Montreal, PQ H3C 3G1 Canada] Cleaning behavior was observed in the laboratory among cyprinodontid fishes parasitized with monogenetic trematodes and leeches. /Fundulas majalis/ elicited cleaning behavior from /Cyprinodon variegatus/ by assuming a head-down position with compensatory fin movements. In a high intensity display the host may be completely vertical with an S-shaped curve to the body. When picked at by the cleaner, the host may jerk and swim away but ofter returns to pose again in the invitation position. /Cyprinodon variegatus/ and /Lucania parva/ were observed to clean intraspecifically. In each case the invitation to be cleaned consists of a head-up pose with compensatory fin movements. Occasionally intraspecific soliciting of cleaning occurs. /Cyprinodon variegatus/ also cleans /L. parva/. These invitation poses may have evolved from intraspecific appeasement or submissive postures to serve for interspecific communication.

76-000633 Danyulite, G. P.; Maksimov, Yu. M. CHARACTERISTICS OF THE OPTOMOTOR REACTION OF FISHES ACTED UPON BY A PULSED ELECTRIC FIELD. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (4): 604-607. 1974. SFA 21(2).

[Inst. Zool. Parasitol., Lith. Acad. Sci., Klaypeda, USSR] A stable optomotor reaction, the manifestation of which was not disturbed by the effect of the electric field of a unipolar sinusoidal pulsed current (f = 30 Hz, T = 1.6 msec), which caused stimulation and produced the threshold of anode electrotaxis in the fish, was discovered in the smelt. Considerable adaptation of the fish to the action of the electric current was noted: the optomotor reaction of the smelt was disturbed by a comparatively strong electric current, but began to be restored within 30-50 sec. Disturbance to the optomotor reaction of the smelt was observed under the influence of an electric field producing distinct anode electrotaxis and electronarcosis. --Concl.

76-000634 Edel, R. K. LOCOMOTOR ACTIVITY OF ADULT-SIZED AMERICAN EELS (/ANGUILLA ROSTRATA/ LESUEUR): EFFECTS OF SHELTER AVAILABILITY, INDUCED MATURATION AND SENSORY IMPAIRMENT. Ph.D. dissertation, Univ. R. I. 167p. 1975. From Diss. Abstr. Int. B Sci. Eng. 36((10), 1976. SFA 21(2).

The environmental cues available to migratory eels are many, but which are used, or which sensory modalities dominate are unknown. Since the migrating eels must swim at least 1,000 Km, perhaps as many as 3,000 Km, locomotor activity can be used to measure the responses of eels in different stages of maturity to environmental parameters. The 5 manuscripts contained in this dissertation describe experiments designed to test the effects of shelter availability on the activity of migratory eels; to evaluate the induction of maturation of female eels through hormonal injections; to describe the locomotor activity of maturing female eels under various artificial photocycles; and to describe the effects of sensory impairment on the activity of non-migratory eels under an artificial photocycle and constant conditions. Shelter availability modulated the amplitude of activity. When shelter was present, low levels of both hourly and daily activity were exhibited. The induction of maturation of female eels through hormonal injections was shown to be both practical and efficient. Powdered carp pituitaries, injected intramuscularly, were an efficacious gonadal stimulant. Five maturing eels and six non-maturing silver eels were held in activity-monitoring tanks in 1974. The resultant patterns of locomotor activity suggested that maturing eels respond somewhat differently than immature eels to artificial photocycles. Maturing eels seemed to be arhythmic or diurnal although they continued to respond to light-dark transitions. Twilight periods, especially dusk, may be the preferred time of spawning. Blinded eels became rhythmic before anosmic or lateral-line-ablated eels did. Blinded eels displayed circadian rhythmicity under constant light suggesting the presence of an innate timing mechanism or sensitivity to unknown, subtle zeitgebers. --From abstr.

76-000635 Fernet, D. A.; Smith, R. J. F. AGONISTIC BEHAVIOR OF CAPTIVE GOLDEYE (/HIODON ALOSOIDES/). J. Fish. Res. Board Can. 33 (4,1): 695-702. Apr. 1976. In English with French summ. SFA 21(2).

[Dep. Tourism Renewable Resour., Saskatchewan Fish. Lab., 30 Campus Dr., Saskatoon, SK S7N 0X1, Canada] Captive goldeye (/Hiodon alosoides/) (ages 0, I, V-VIII) in clearwater tanks demonstrated a well-developed agonistic repertoire which included charging, chasing, nipping, and lateral displays. We postulate that this agonistic behavior serves as a spacing mechanism in goldeye ecology, allowing fish to defend an individual distance or territory. Age 0 and age I

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fish showed higher frequencies of direct attack than adults (greater than age V) which used displays more frequently. In paired encounters, females, smaller fish, and introduced fish won more fights than males, larger fish or resident fish, a situation which differs from the usually accepted relationships between fighting success and size, sex, or residency. Ripe adults were less aggressive than nonripe adults.

76-000636 Gendron, R. P.; Mayzel, K. ASSOCIATION OF /THALASSOMA BIFASCIATUM/ WITH /CONDYLACTIS GIGANTEA/ IN THE BAHAMAS. Copeia 1976 (2): 382-384. May 1976. SFA 21(2).
[Dep. Zool., Duke Univ., Durham, NC 27706]

76-000637 Gorlick, D. L. DOMINANCE HIERARCHIES AND FACTORS INFLUENCING DOMINANCE IN THE GUPPY /POECILLA RETICULATA/ (PETERS). Anim. Behav. 1976 (2): 336-346. May 1976. SFA 21(2).
[Dep. Zool., Univ. Hawaii, Honolulu 96822] Dominance behaviour and factors influencing dominance were investigated in small heterosexual and homosexual groups of guppies (/Poecilia reticulata/) in the laboratory. Straight line nip-right hierarchies were the most frequent type of dominance relationship. In heterosexual groups separate homosexual hierarchies were formed, and females were the more dominant sex. Dominant males performed significantly more reproductive behaviour than lower rank individuals. Agonistic behaviour appears early in young /P. reticulata/. Factors involved in determining dominance were size, sex and aggressiveness. Individual or role recognition or both may occur in this species. Advantages of dominance are discussed.

76-000638 Gray, N. L.; Marshall, J. A. THE EFFECT OF SIZE AND EXPERIENCE ON SOUND PRODUCTION DURING MALE-MALE AGONISTIC BEHAVIOR IN /TRICHOPSIS VITTATUS/. Proc. W. Va. Acad. Sci. 48 (1): 28. 1976. Abstract only. SFA 21(2).
[Dep. Biol., W.Va. Univ., Morgantown 26506] /Trichopsis vittatus/ adults produce specific sounds during agonistic and reproductive behaviors. The number of sounds produced by an individual during an agonistic encounter was variable. Preliminary studies have indicated that both size and experience are important factors contributing to the variability. This study attempts to determine the influence of these two factors (size and experience) on accustic signaling of resident fish when confronted with intruders.
Results indicate the equal and larger sized intruders tend to elicit more sound production than do smaller intruders. Further, residents that have had prior experience with intruders tend to emit more sounds.

76-000639 Heiligenberg, W. THE INTERACTION OF STIMULUS PATTERNS CONTROLLING AGGRESSIVENESS IN THE CICHLID FISH /HAPLOCHROMIS BURTONI/. Anim. Behav. 1976 (2): 452-458. May 1976. SFA 21(2).
[Neurobiol. Unit, Scripps Inst. Oceanogr., A004 U.C.S.D., La Jolla, CA 92093] Readiness to attack is controlled by various stimulus patterns displayed in the context of social behaviour. The effect of such stimulus patterns and their combinations can be measured in terms of behavioural quantities. In search of algorithms, /f/(/a,b/), describing the combined effect of two stimulus patterns, /a/ and /b/, those solutions are of particular interest which represent /f/ as the combination of two terms, /f/(1)(/a/), and /f/(2)(/b/), which each depend on one stimulus pattern only. The existence of such solutions supports the assumption of independent processes controlled by /a/ and /b/ respectively. Social communication is viewed as a process in which

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a 'sender' manipulates and controls states of behavioural readiness in a 'receiver'. 'Threat' displays, in particular, are suggested to tip the balance between aggressive and submissive tendencies in either direction, with the probability of the outcome largely depending upon the initial disposition of the receiver.

76-000640 Hoff, J. G. CONTRIBUTION TO THE BIOLOGY OF THE SEABOARD GOBY, /GOBIOSOMA GINSBURGI/. Copeia 1976 (2): 385-386. May 1976. SFA 21(2).
[Dep. Biol., Southeast. Mass. Univ., North Dartmouth 02747] The seaboard goby has never been abundant in collections and when present, its habitat has been described as deeper water. This paper records an inshore shallow water, low oxygenated habitat for this species. These field observations, along with short term low oxygen experiments, indicate that /G. ginsburgi/ is well adapted tc live in sewage polluted estuaries. --From results

76-000641 Huntingford, F. A. THE RELATIONSHIP BETWEEN ANTI-PREDATOR BEHAVIOUR AND AGGRESSION AMONG CONSPECIFICS IN THE THREE-SPINED STICKLEBACK, /GASTEROSTEUS ACULEATUS/. Anim. Behav. 1976 (2): 245-260. May 1976. SFA 21(2).
[Dep. Zool., Univ. Glasgow, Scotland] The response of individual breeding three-spined sticklebacks to territorial intruders of various species was compared with their response to a predator outside the breeding season. The nature of the territorial response to the different intruders, as revealed by factor analysis, was very similar and the level of aggression shown to the different species co-varied across individuals and during each breeding cycle. The level of territorial aggression of the individual fish was positively correlated with their 'boldness' towards a predator. These results provide tentative support for the idea that anti-predator behaviour and aggression towards conspecifics are linked in this species. Supporting evidence for and possible adaptive significance of these results are discussed.

76-000642 Krivtsov, Yu. M.; Protasov, V. R. THE EFFECT OF LASER BEAMS ON THE BEHAVIOR OF FISHES. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (3): 449-451. 1974. SFA 21(2).
[IEMEZh, USSR Acad. Sci., Moscow, USSR] It was noted as a result of carrying out the experiments that the fishes did not react by a behavioral motor reaction to laser beams; morecver laser beams do not apparently effect the vision of fishes. Therefore, the fact that lasser beams do not have an effect on the behavior of fishes offers prospects for their use in submarine fisheries research as lighting sources in submarine cinematography and photography or in the development of laser holography. --From text

76-000643 Marshall, J. A. SCUND PRODUCTION BY FRESHWATER FISHES--A BIBLIOGRAPHY. Proc. W. Va. Acad. Sci. 48 (1): 59-67. 1976. SFA 21(2).
[Dep. Biol., W. Va. Univ., Morgantown 26506]

76-000644 McKaye, K. R.; Barlow, G. W. CHEMICAL RECOGNITION OF YOUNG BY THE MIDAS CICHLID, /CICHLASOMA CITRINELLUM/. Copeia 1976 (2): 276-282. May 1976. SFA 21(2).

[Dep. Biol., Yale Univ., New Haven, CN 06520] /Cichlasoma citrinellum/ recognizes the odor of its young when paired against the odor of young in conspecifics or young of other cichlid species. This ability is lost when the nares are plugged with cotton. During the larval stage the female remains with the young while the male patrols the "territory." Site attachment by the female, but not by the male, interferes with orientation to water coming from the larvae. Site attachment ceases to interfere with this chemical orientation when the young become free-swimming. Orientation to the odor of young is believed to be important 1) in the location, formation and maintenance of the school of fry, and 2) in the detection and removal of foreign fry.

76-000645 Ovcharov, O. P. THE MANEUVERABILITY OF FISHES. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (4): 582-588. 1974. SFA 21(2).

[Inst. Biol. South. Seas, Ukr. Acad. Sci., Sevastopol, USSR] The mechanism of turning and the characteristics of streamlining in the execution of the maneuver by fishes are examined in original visualized kinograms. It is established that a dynamically stable position of the body is maintained in the execution of a horizontal maneuver in fishes with the "scombroid" type of propulsion.

76-000646 Radakov, D. V.; Silva, A. SOME CHARACTERISTICS OF THE SCHOOLING BEHAVIOR OF /JENKINSIA LAMPROTAENIA/. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (2): 283-286. 1974. SFA 21(2).

[Inst. Oceanol., Cuban Acad. Sci., Havana, Cuba]

76-000647 Richards, S. W. MIXED SPECIES SCHOOLING OF POSTLARVAE OF /AMMODYTES HEXAPTERUS/ AND /CLUPEA HARENGUS HARENGUS/. J. Fish. Res. Board Can. 33 (4,1): 843-844. Apr. 1976. In English with French summ. SFA 21(2).

[Little Harbor Lab., Inc., Guilford, CN 06437] Small schools of post-larval /Ammodytes hexapterus/ and /Clupea harengus harengus/ were observed and captured at Margaree Harbor entrance in the Gulf of St. Lawrence on July 20, 1974 and captured at Goldsmith Inlet beach in Long Island Sound on April 18, 1975. These species appeared similar, yet /A. hexapterus/ averaged 14 mm longer than /C. harengus harengus/ at Margaree, but 9 mm shorter than herring at Goldsmith Inlet Beach. In both areas sand lances were narrower than herring.

Post-larval /A. hexapterus/ do not bury in the sand, and they will school together with post-larval /C. harengus harengus/ regardless of the differences in sizes between the two species.

76-000648 Rosenblatt, R. H.; Johnson, G. D. ANATOMICAL CONSIDERATIONS OF PECTORAL SWIMMING IN THE OPAH, /LAMPRIS GUTTATUS/. Copeia 1976 (2): 367-370. May 1976. SFA 21(2).

[Scripps Inst. Oceanogr., Univ. Calif., La Jolla 92037]

76-000649 Silverman, H. I. EFFECTS OF VISUAL SOCIAL STIMULATION ON REPRODUCTION IN /TILAPIA MOSSAMBICA/ (PETERS); PISCES:CICHLIDAE. Ph.D. dissertation, Univ. Calif. (Davis) p164p. 1975. From Diss. Abstr. Int. B Sci. Eng. 36(12), 1976. SFA 21(2).

Visual social stimulation of reproduction and behavior was studied in approximately 250 juvenile and adult /Tilapia mossambica/, an east African mouthbrooding cichlid fish.

In juveniles, exposure to a conspecific lowered the age at first spawning compared to isolates. Growth of social females lagged behind that of isolate females. Males reared in visual contact with females grew more slowly than males reared in visual contact with other males. Two general mechanisms for effects upon the ovaries were discusses: (a) Social stimuli acted only as an ovulatory trigger; (b) social stimuli hastened ovarian growth generally. Assuming differential female growth was related to the energy stress of yolk deposition, (b) accounted better for the results. Advantages of social stimulation of first spawning include more rapid population buildup and the production of more young, hence more adults per unit time.

For mature fish of both sexes there was heightened reproductive activity for unlimited contact fish compared tc isolates. Visual-only groups were intermediate.

There were significant, negative correlations between several male displays and female spawning interval for male-female pairs residing in the same or adjacent aquaria. Observations over a spawning interval showed that in addition to significantly elevated display frequencies in the unlimited contact situation, three of the five displays increased as spawning approached. There was little change in the visual-only case. Latency of response and relative frequency of first display histograms showed greater variability of latency and first display after male or female approach in the visual-only group compared to unlimited contact fish. Loss of chemical information and movement inhibition best accounted for the differences between groups. Interference with recognition of females by males was considered in relation to the greater response variability of the visual-only group. Unlike male maternal-brooders, females do not exhibit characteristic nuptual coloration, thus males probably make greater use of nonvisual cues in recognizing females than the reverse. --From abstr.

76-000650 Tat'yankin, Yu. V. THE EFFECT OF THE PRELIMINARY ADAPTATION TEMPERATURE ON THE DISTRIBUTION OF JUVENILE COD [/GADUS MORHUA MORHUA/] AND POLLOCK [/POLLACHIUS VIRENS/] WITHIN A TEMPERATURE GRADIENT. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (5): 755-760. 1974. SFA 21(2).

[Mar. Bio. Inst., Murmansk, USSR] A relationship has been established between the temperatures selected by juvenile cod and pollock and the temperature at which they were kept before the experiment. It has been found that the selected temperature is shifted in the direction of the effect of the adaptation temperature. Specific differences in the nature of adaptation have been elucidated. Adaptation to high temperatures is a faster process than adaptation to low temperatures, and it shifts the selected temperature to a greater extent.

76-000651 Thresher, R. E. FIELD ANALYSIS OF THE TERRITORIALITY OF THE THREESPOT DAMSELFISH, /EUPOMACENTRUS PLANIFRONS/ (POMACENTRIDAE). Copeia 1976 (2): 266-276. May 1976. SFA 21(2).

[Rosenstiel Sch. Mar. Atmos. Sci., Univ. Miami, 4600 Rickenbacker Causeway, Miami, FL 33149] Observations made by means of an underwater television system, supplemented by model-bottle experiments, indicated that under field conditions, members of /E. planifrons/ defend a serial territory against a variety of species. During more than 30 hrs of observation, residents drove from their territories members of 22 species. The majority of these attacks were against three groups of fishes--parrotfishes (Sparidae), surgeonfish (Acanthuridae) and grunts (Pomadasyidae). Intraspecific chases accounted for only 5 percent of the total number of chases observed. A chase occurred on the average once every 6 minutes. Frequency of chases against a species correlated significantly with both the frequency and duration with which members of that species entered the video camera's field of view (these measures being used as an approximation of the abundance of the various species in the study area). However, the size of the territory maintained against a given species did not. Rather, this seemed to be a function of the degree to which an intruding species threatened three rescurces required by the damselfish--a food supply, its spawn and a shelter hole.

76-000652 Timms, A. M. THE EFFECTS OF VISICN ON THE GENERAL LOCOMOTOR BEHAVIOUR OF THE GOLDFISH, /CARASSIUS AURATUS/. Anim. Behav. 1976. (2): 376-380. May 1976. SFA 21(2).

[Conserv. Counc. Ontario, 6th Floor, 45 Charles St. East, Toronto, ON M4Y 1S2, Canada] Comparison of the locomotor behaviour of normal, unilaterally and bilaterally blinded goldfish (/Carassius auratus/) demonstrated the roles of perspective vision (depth perception), which required binocular vision, and of vision provided by only cne eye, in the control of locomotion. Because normal and bilaterally blinded fish exhibited similar size and direction of angles of turn, a similar number of consecutuve turns in the same direction and the same turning frequency, normal binocular vision plays no role in the control of turning behaviour. Unilaterally blinded fish exhibited a strong bias in turning behaviour which resulted in their displaying circus movements toward the blinded side, a direction opposite to that reported by others for both invertebrates and vertebrates with unilateral sensory elimination. The mean step length was significantly increased by both uni- and bilateral blinding, and its temporal relationship with turning frequency and distance swum was also changed. Perspective vision (binocular) therefcre controls these parameters. The significantly lower velocity of bilaterally blinded fish and the similarity between the other two test groups, indicated that sight by one eye only was sufficient to mediate velocity control.

76-000653 Webb, P. W. HYDRODYNAMICS AND ENERGETICS OF FISH PROPULSION. Bull. Fish. Res. Board Can. 190. 159p. 1975. In English with French summ. SFA 21(2).

[Dep. Environ., Pacific Biol. Stn., Nanaimo, BC V9R 5K6, Canada] Principles of hydrodynamics are discussed, oriented to biologists. Following a discussion of kinematics and swimming performance, the hydrodynamic principles are applied in discussing the fundamental problem of drag and thrust. The traditionally employed rigid-body analogy (theoretical drag calculation for equivalent rigid bodies or dead-drag measurements on fish with the body stretched straight) is not considered a valid assumption from which swimming thrust (= drag) power may be computed. Movements made by most fish during swimming are likely to severely distort flow. As a result, the flow around a swimming fish is not likely to be mechanically equivalent to that

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assumed by the rigid-body analogy.

Alternative methods of calculating thrust power from hydrodynamic models based on the movements of swimming fish are discussed.

A variety of mechanisms to reduce the drag of swimming fish has been proposed in the literature. Only a few are likely to operate. These include special body shapes in fish that swim with the bulk of the body held fairly straight, distributed dynamic damping in /Desmodema/, distributed viscous damping possibly in cetaceans, induction and maintenance of turbulent boundary-layer flow tc avoid premature separation, vortex sheets filling fin gaps, and vortex interaction among schooling fish. Mucus may be a universal drag-reducing mechanism among fish.

Principles of biological energy metabolism are discussed oriented to nonbiologists. Biological energetics and mechanics are integrated in a discussion of propulsion efficiency. The use of hydromechanical models is supported providing reasonably complete data are available. Efficiency studies emphasize biological areas requiring additional research.

Discussion is largely restricted to caudal fin and body propulsion at relatively low activity levels. Few data are available for other propulsion modes. A preliminary model is constructed to describe mechanical energy expenditure during acceleration. This suggests that highest final swimming speeds are reached in the shortest time with lowest energy expenditure at highest acceleration rates.-- From abstr.

LIFE HISTORIES-GENERAL WORKS

76-000654 Able, K. W.; Musick, J. A. LIFE HISTORY, ECOLOGY, AND BEHAVIOR OF /LIPARIS INQUILINUS/ (PISCIS: CYCLOPTERIDAE) ASSOCIATED WITH THE SEA SCALLOP, /PLACOPECTEN MAGELLANICUS/. NOAA Fish. Bull. 74 (2): 409-421. Apr. 1976. SFA 21(2).

[Biol. Dep., McGill Univ., Montreal, PQ, Canada] In the Mid-Atlantic Bight, spawning of /Liparis inquilinus/ peaked near shore, away from sea scallop beds, in March and April. In the laboratory, females appeared to initiate spawning activity and each female probably spawned more than once. The eggs are adhesive and demersal and have been found attached to hydroids in nature. The larvae were most abundant in plankton collections inshore in May and averaged 5 mm total length at that time. Larger larvae were found in deeper water, and by 12-13 mm total length they had undergone metamorphosis and descended to the bottom where they became associated with the sea scallop, /Placopecten magellanicus/. They maintained this association from August through December. The population comprises a single year class which leaves the scallops and migrates inshore to spawn as the fish are entering their second year.

Laboratory and field observations indicated that fish were more abundant in the scallops and more scallops contained fish during the day. At night, fish left the scallops to feed cn small crustaceans. /Liparis inquilinus/ observed in aquaria used the fin rays of the lower lobe of the pectoral fin to detect food. These fin rays have taste buds on the surface of each ray.

/Liparis inquilinus/ is probably protected frcm predation while inside sea scallops since there are few predators on the scallops of the size usually occupied. Predation while outside the scallop may be minimized by feeding only at night and then returning as soon as the fish becomes satiated. Sea scallops seem to suffer no ill effects from the association and they do not compete for food with /L. inquilinus/ since /P. magellanicus/ is a microplanktonic filter feeder and the former feeds on small crustaceans.

76-000655 Amanov, A. A. MORPHOLOGY AND MODE OF LIFE OF THE AMUR SNAKEHEAD [/OPHIOCEPHALUS ARGUS WARPACHOWSKII/] IN CHIMKURGAN RESERVOIR. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (5): 713-717. 1974. SFA 21(2).

[Inst. Zool. Parasitol., Tadzhik Acad. Sci., Dushanbe, USSR] Information is given on the morphology and ecology (spawning time, fecundity, rate of growth, feeding etc.) of the Amur snakehead (/Ophiocephalus argus warpachowskii/) of Chimkurgan reservoir.

76-000656 Amanov, A. A.; Turdakov, F. A.; Devonov, M. D. THE TURKESTAN CATFISH /GLYPTOSTERNUM RETICULATUM/ OF THE TRIBUTARIES OF THE AMUDAR'YA. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (6): 847-855. 1974. SFA 21(2).

[Y. N. Pavlovskiy Inst. Zool. Parasitol., Tadzhik Acad. Sci., USSR] Information is given on the morphology, age-related, sexual and local variability of the Turkestan catfish, /Glyptosternum reticulatum/, in the tributaries of the Amudar'ya and Syrdar'ya rivers. The time of spawning has been established and fecundity and feeding have been investigated.

76-000657 Burnett-Herkes, J. CONTRIBUTION TO THE BIOLOGY OF THE RED HIND, /EPINEPHELUS GUTTATUS/, A COMMERCIALLY IMPORTANT SERRANID FISH FROM THE TROPICAL WESTERN ATLANTIC. Ph.D. dissertation, Univ. Miami 166p. 1975. From Diss. Abstr. Int. B Sci. Eng. 36(12), 1976. SFA 21(2).

Growth curves derived from modal length frequencies of population samples and from analysis of banding on otoliths and back-calculation of body lenghts of red hinds from Bermuda resulted in a von Bertalanffy growth equation of: 1(t) = 420(1 - e to the -0.18(t + 0.44)). A Walford line plot yielded an asymptotic standard length of 420 mm (507 mm TL) and slope of k = 0.83. The coefficient of growth (K) was 0.18. Age at sexual maturity and recruitment to the fishery was three years (240 mm TL); fecundity ranged from 89,600 eggs to 3, 364,900 eggs for females of 248 mm TL and 457 TL respectively. At Bermuda, 93 percent of red hinds were infected with a larval cestode, /Callitetrarhynchus gracilis/ and 13 percent had gonadal infections of a nematode, /Philometra/ sp. At St. Croix, 31 percent of red hinds were infested with a cymothiod isopod, /Anilocra laticauda/. This isopod was absent at Bermuda. Estimates of mortality rates indicated the Bermuda population was underexploited during 1973 and 1974. --From abstr.

76-000658 Carlson, H. R.; Haight, R. E. JUVENILE LIFE OF PACIFIC OCEAN PERCH, /SEBASTES ALUTUS/, IN COASTAL FIORDS OF SOUTHEASTERN ALASKA: THEIR ENVIRONMENT, GROWTH, FOOD HABITS, AND SCHOOLING BEHAVIOR. Trans. Am. Fish. Soc. 105 (2): 191-201. Mar. 1976. SFA 21(2).

[NMFS, Auke Bay Lab., P.O. Box 155, Auke Bay, AK 99821] Schools of juvenile Pacific ocean perch, /Sebastes alutus/, at four coastal fiord sites in southeastern Alaska were sampled by trawling. Younger juveniles (ages I and II) were over rougher substrate than older juveniles (ages III-V); both age groups were at shallower depths than adults. Lengths of juvenile perch varied between and within geographic areas, but the pattern of variation was not consistent. The most important food items were copepods and euphausiids; younger juveniles fed more on copepods and older juveniles more on euphausiids. Feeding activity was minimal in late winter and early spring. The relative strength of year classes fluctuated widely. Some juvenile perch are

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shown to become demersal by age I, and the hypothesis of a 2-3-year early pelagic existence is rejected.

76-000659 Dew, C. B. A CONTRIBUTION TO THE LIFE HISTORY OF THE CUNNER, /TAUTOGOLABRUS ADSPERSUS/, IN FISHERS ISLAND SOUND, CONNECTICUT. Chesapeake Sci. 17 (2): 101-113. June 1976. SFA 21(2).
[Lawler, Matusky, and Skelly Engineers, 415 Route 303, Tappan, NY 10983] During February through December 1969 I investigated a nearshore population of cunners, /Tautogolabrus adspersus/ (Labridae) in Fishers Island Sound off the coast of Connecticut and Rhode Island. I examined length-weight relationships and seasonal changes in condition, age and growth, spawning period, age at maturity and sex ratio; nocturnal and winter habits were observed using SCUBA. No significant difference was observed between male and female length-weight equations when gonads and stomach contents were removed. Body condition, possibly related to fat storage prior to overwintering, improved perceptibility from spring through fall, and fall condition was significantly better than spring and summer condition. Males were larger than females of the same age, and maximum readable age for both sexes was five years. Both males and females matured and spawned during their second year of growth when one year old. The spawning period was well defined and occurred primarily during June. I found an overall male to female sex ratio of 2.2:1. The predominance of males over females increased for older fish, indicating greater longevity for male cunners. Nocturnal behavior consisted of a quiescent, resting attitude accompanied by a camouflaging pattern change in those cunners most exposed to view. Activity dwindled in the fall until a state of dormancy was reached at about 7 to 8C, with the larger fish becoming dormant first. Cunners overwintered in the same inshore areas where they were found during other times of the year.

76-000660 Evans, L.; Tarter, D. ECOLOGICAL LIFE HISTORY OF THE GRASS PICKEREL, /ESOX AMERICANUS VERMICULATUS/, IN A WEST VIRGINIA STREAM. Proc. W. Va. Acad. Sci. 48 (1): 4. 1976. Abstract only. SFA 21(2).
[U.S. Army Corps Eng., Huntington, WV 25721] The ecological life history of the grass pickerel, /Esox americanus vermiculatus/ Lesueur, was studied in Twelvepole Creek, Wayne Co., West Virginia, from September 1970 until September 1972. Adult pickerel migrated into shallow oxbow lakes with spring and autumn floods to reproduce. During the first year of life, the pickerel which hatched in one such oxbow remained in the spawning area. Gravid pickerel collected from a tributary of Twelvepole Creek spawned in laboratory aquaria. At spawning, diameters of pickerel eggs ranged from 1.91 to 2.18 mm; the average was 2.0 mm. The size of pickerel in laboratory aquaria was 4.52 mm. The growth rate of pickerel in laboratory aquaria was 0.41 mm per day. Five age groups of pickerel were in the population. In one oxbow lake, fall spawning and multiple spring spawning occurred in 1970 and 1971, respectively. Stomach analyses of pickerel showed the following succession of food types with increasing total lengths: microcrustaceans to macrocrustaceans, then insects, and finally, fishes.

76-000661 Fedorova, G. V.; Vetkasov, S. A. THE BIOLOGICAL CHARACTERISTICS AND ABUNDANCE OF THE LAKE ILMEN RUFFE, /ACERINA CERNUA/. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (6): 836-841. 1974. SFA 21(2).

[GosNIORKh, Leningrad, USSR] Data are given on the age and size-weight composition of the Lake Ilmen population of the ruffe, /Acerina cernua/, and also on the onset of sexual maturity and on fecundity. Consideration is given to aspects of the feeding of the ruffe and its food relations with the bream, the main food fish of Lake Ilmen. An account is given of the population dynamics of the ruffe over the last 7 years. The abundance of the ruffe in 1972 is calculated and the catch for 1973 is defined.

76-000662 Gatz, A. J., Jr. THE ECOLOGY OF FISHES IN THREE STREAMS IN NORTH CAROLINA. Ph.D. dissertation, Duke Univ. 361p. 1975. From Diss. Abstr. Int. B Sci. Eng. 36(10), 1976. SFA 21(2).

The ecological relationships among the fishes which occure sympatrically in each of three separate streams in the Piedmont of North Carolina were studied. The relationships studied included both ecological segregation between coexisting pairs of species and patterns of spacing of Hutchinsonian niches for the entire fish communities. Similar streams in three separate drainages were selected for study. Collections of fishes were made in all seasons at each of four to six locations in every stream. fifty-six morphological characters, each of which was assumed to relate to a particular aspect of the ecology of the fishes, were studied for every species. Simple linear correlations between these characters were identified and a factor analysis was performed to determine multivariate interrelatedness of the characters. The variation within species in each continuously varying character was assessed by analysis of variance, and significance of differences between species was determined by Newman-Keuls tests. Gut contents were identified for all species studied. The morphological characters were interpreted based on information in the literature, character correlations, gut content analyses, and field observations. --From abstr.

76-000663 Gaygalas, K. S.; Gyarulaytis, A. B. THE ECOLOGY OF THE PIKE-PERCH (/LUCIOPERCA LUCIOPERCA/) IN THE KURSHYU MARES BASIN, THE STATE OF ITS STOCKS AND FISHERY REGULATION MEASURES. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (4): 514-525. 1974. SFA 21(2).

[Inst. Zool. Parasitol., Lith. Acad. Sci., Vilnius, USSR] Investigations have been made of the growth, feeding, fecundity, spawning and population structure of the pike-perch (/Lucioperca lucioperca/) in the Kurshyu Mares Basin, and of the state of its stocks and the regime of the fishery. It is noted that the overall abundance of the stock and the commercial catches of the pike-perch have contracted appreciably in recent years due to intensified catch of the younger age groups in their main feeding grounds. It is proposed to introduce a new minimum commercial size, to make the pike-perch fishery more specialized and to take other measures in order to restore the abundance of the pike-perch stock.

76-000664 Gaygalas, K. S. THE THREESPINE STICKLEBACK [/GASTEROSTEUS ACULEATUS/] OF THE KURSHYU MARES (COURLAND LAGOON). J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (5): 706-712. 1974. SFA 21(2).
[Inst. Zool. Parasitol., Lith Acad. Sci., Vil'nyus, USSR] A study was made of the morphological characteristics, growth, fecundity, spawning, population structure and migrations of the threespine stickleback (/Gasterosteus aculeatus/) of the Kurshyu mares.

76-000665 Golovan', G. A.; Pakhorukov, N. P. SOME DATA ON THE MORPHOLOGY AND ECOLOGY OF /ALEPOCEPHALUS BAIRDI/ (ALEPOSEPHALIDAE) OF THE CENTRAL AND EASTERN ATLANTIC. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (1): 44-50. 1975. SFA 21(2).
[Fish Location Board, Sevastopol, USSR] In the tropical part of the bathyal zone there are sectors with an increased biomass of nekton, in particular /A. bairdi/. The males and females of /A. bairdi/ are indistinguishable according to morphometric indices. /A. bairdi/ is a bathypelagic fish and stays in a 5-8 m layer, under a macroplankton layer, throughout the day. The bulk of the food of /A. bairdi/ is macroplankton (Coelenterata, /Pyrosoma/, bathypelagic fishes). Aggregations of this species are confined to the dense concentrations of food macroplankton. --From concl.

76-000666 Gordina, A. D.; Duka, L. A.; Oven, L. S. SEXUAL DIMORPHISM, FEEDING AND REPRODUCTION OF /GOBIUS BUCCHICHI/ IN THE BLACK SEA. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (4): 533-538. 1974. SFA 21(2).
[Inst. Biol. South. Seas, Ukr. Acad. Sci., Sevastopol, USSR] Information is given concerning the feeding of /Gobius bucchichi/, the spawning period, the nature of egg laying, fecundity and the morphological differences between females and males.

76-000667 Gubanov, Ye. P.; Grigor'yev, V. N. OBSERVATIONS ON THE DISTRIBUTION AND BIOLOGY OF THE BLUE SHARK /PRIONACE GLAUCA/ (CARCHARHINIDAE) OF THE INDIAN OCEAN. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (1): 37-43. 1975. SFA 21(2).
[AzCherNIRO, Kerch, USSR] The blue shark is widespread in the Indian Ocean, from Africa to Australia, Indonesia and the Nicobar Islands between 17°N and 37°S. The maximum abundance, size and weight are observed in the western part of the equatorial zone of the Indian Ocean (from the east coast to Africa to longitude 60°E, between latitudes 10°N and 10°S), where their living conditions are evidently most favorable. The greatest frequency of occurrence is recorded in deep-sea areas at a considerable distance from the coast, and from bottom elevations. Blue sharks reach a length of 348 cm and a weight of 210 kg (average 246.4 cm and 71.2 kg). The males are smaller than the females. They become sexually mature at a length of 180 cm and a weight of 55 kg and produce between 10 and 135 young; the number of young does not depend on the size and weight of the mother. Blue sharks are predators and feed on various species of animals. --From concl.

76-000668 Redkozubov, I. Yu.; Movchan, V. A. A CONTRIBUTION TO STUDY OF THE LAKE PROLIKH CHAR [/SALVELINUS ALPINUS ERYTHRINUS/]. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (2): 289-291. 1974. SFA 21(2).
[Kaliningrad Fish. Tech. Inst., USSR]

76-000669 Solovkina, L. N. THE EUROPEAN CISCO [/COREGONUS ALBULA SARDINELLA/] OF THE PECHORA BASIN. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (5): 666-677. 1974. SFA 21(2).
[Komi Dep., All-Union Hydrobiol. Soc., Syktyvkar, USSR] A description is given of the various forms of the European cisco in the Pechora Basin (the semidiadromous form and the freshwater forms), on which basis it is possible to compare their differences, and similarity. Consideration is given to characteristics of the distribution of the White Sea cisco, the main systematic characters and fisheries and biological characteristics of its Pechoran members, and information on natural reproduction and feeding. The state of the stocks is evaluated.

76-000670 Tanasiychuk, V. S. THE ADAPTIVE CAPABILITIES OF THE PIKE-PERCH [/LUCIOPERCA LUCIOPERCA/]. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (5): 698-706. 1974. SFA 21(2).
[UkrNIIRKh, Kiev, USSR] Alteration of growth rate, time of maturation and fecundity of the pike-perch (/Lucioperca lucioperca/) is related to environmental conditions. It is established that the growth rate and time of maturation are related to the life span of the pike-perch.

76-000671 Thompson, G. E.; Davies, R. W. OBSERVATIONS ON THE AGE, GROWTH, REPRODUCTION, AND FEEDING OF MOUNTAIN WHITEFISH (/PROSOPIUM WILLIAMSONI/) IN THE SHEEP RIVER, ALBERTA. Trans. Am. Fish. Soc. 105 (2): 208-219. Mar. 1976. SFA 21(2).
[Alberta Dep. Rec., Parks, Wildl., Fish Wildl., J. J. Bowlen Bldg., Calgary, AB, Canada] The ecology of mountain whitefish (/Prosopium williamsoni/) in the upper Sheep River was studied during 1972 and 1973. Mountain whitefish spawned from late September to mid-October in shallow, fast, midstream areas. The number of spawning fish on each spawning site was small (two to 20 fish per site). Absolute fecundity (eggs/fish) increased as the females became older; however, relative fecundity (eggs/g of fish) remained comparatively stable for all age classes. The linear regression of absolute fecundity (Y) on fork length (X, in mm) is described by the formula: Y = 4347.6 + 50.7 (X-301.5). Growth is rapid except in the older age classes of 7 and 8. The weight (Y, in g) length (X) relationship (sexes combined) is described by the formula: log Y = 2.1967 + 3.2108 (log X-2.3710). The relationship of body (Y) to scale (X) growth is described by: log Y = 2.0891 + 0.9542 (log X-2.4367). Recruitment into the population of the upper Sheep River appeared to be at 3 years of age with an annual natural mortality rate of approximately 33 percent on 3-year-old and older mountain whitefish. The diets of mountain whitefish consisted primarily of dipterans, ephemeropterans, trichopterans, and terrestrial invertebrates.

76-000672 Trunov, I. A.; Malevanyy, A. P. ON THE ECOLOGY OF SEAROBINS [TRIGLIDAE] OFF NAMIBIA. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (3): 367-373. 1974. SFA 21(2).
[AtlantNIIRO, Kaliningrad, USSR] The most abundant members of the family Triglidae in Namibian shelf waters are /Trigla lyra/ and /Chelidonichthys capensis/. Consideration is given to some aspects of the ecology of these species. It is established that the southern boundary of the range of /T. lyra/ reaches the Tropic of Capricorn, while /Ch. capensis/ is of almost universal distribution. Searobins are intermittent spawners that spawn all the year round. Both members of the family are predators. /T. lyra/ feeds mainly on crabs and mantis crabs, while /Ch. capensis/ feeds on grenadiers.

76-000673 Wenner, C. A. ASPECTS OF THE BIOLOGY AND MORPHOLOGY OF THE SNAKE EEL, /PISODONOPHIS CRUENTIFER/ (/PISCES, OPHICHTHIDAE). J. Fish. Res. Board Can. 33 (4,1): 656-665. Apr. 1976. In English with French summ. SFA 21(2).
[Va. Inst. Mar. Sci., Gloucester Point 23062] Variability in meristic and morphometric characters and denition of the snake eel, /Pisodonophis cruentifer/, is presented. /Pisodonophis cruentifer/ is distributed from the Laurentian Channel in the north to just north of Cape Hatteras in the south and is most abundant between 150 and 400 m in the Norfolk Canyon area. Males collected in June 1973 possessed mature spermatozoa in testicular tissue while females had yolk-laden eggs 0.6-1.0 mm in diameter. The total length-fecundity relation is log(10)y = 4.28696(log(10)x) - 7.33402, where y = total fecundity and x = total length in millimeters. Gross and microscopic morphology of the gonads is presented. Morphological adaptations of /P. cruentifer/ for burrowing into the substrate are contrasted with the benthopelagic eel, /Synaphobranchus affinis/, and actual burrowing into the substrate is documented.

76-000674 Yaremenko, V. V. THE ECOLOGY OF THE TSIMLYANSK RESERVOIR VIMBA (/VIMBA VIMBA CABINATA/). J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (4): 595-599. 1974. SFA 21(2).
[State Res. Inst. Lake River Fish., Volgograd, USSR]

## POPULATION STUDIES, PRODUCTION, ETC.

76-000675 Bahr, L. M.; Day, J. W., Jr. ENERGY COST ACCOUNTING OF FISHERY PRODUCTION IN LOUISIANA. Presented at the 39th Annu. Meeting, Am. Soc. Limnol. Oceanogr., Savannah, Ga., June 21-24, 1976. 1976. SFA 21(2).
[La. State Univ., Baton Rouge 70803] The coefficient of energy conversion from autotrophs to upper levels marine fishes in Louisiana was calculated at 0.06 percent, based on estimates of total annual gross primary production ($5.0 \times 10^{14}$ Kcal) and total secondary production of top carnivores ($3.0 \times 10^{13}$ Kcal) in the coastal zone. A theoretical food web schematic was then derived from data on the Louisiana estuarine-wetland system, in which 8 physical and biological trophic steps were identified and quantified. Natural energy "costs" associated with each trophic level were calculated from the schematic. These data were used to derive the level of gross primary production required to support the Louisiana fishery of $5.2 \times 10^{11}$ Kcal/yr. From these considerations, we conclude that a reduction in primary production will be reflected in a decline in the fishery. Fossil fuel work equivalents and an energy:money ratio were used to derive the equivalent dollar value of natural work services ($700 \times 10^{6}$) required

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to support the fishery production.

76-000676 Golovan, G. A. THE COMMERCIAL AND BIOLOGICAL CHARACTERISTICS OF THE HAKE (/MERLUCCIUS MERLUCCIUS/) OF THE SOUTHEAST ATLANTIC BETWEEN OCTOBER 1969 AND JANUARY 1970. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (4): 526-532. 1974. SFA 21(2).
[Sevastopol Dep. Fish. Prospect. Res. Fleet Board South. Basin, Yrgrybpromrazvedka, USSR] An account is given of the distribution of the fish fauna in the deepwater region, with particular reference to the biology of the hake, on the basis of the work of fishery survey vessels in the Southeast Atlantic. Data are given on size composition, the ratio of females and males, sexual maturity and distrubition to a depth of 1000 m. Consideration is given to the food spectrum and the role of individual items in the diet. It is shown that several changes occur in the diet as depth increases.

76-000677 Jester, D. B. PRODUCTION OF ROUGH OR COMMERCIAL FISHES IN ELEPHANT BUTTE LAKE, NEW MEXICO. Trans. Am. Fish. Soc. 105 (2): 222-231. Mar. 1976. SFA 21(2).
[Dep. Fish. Wildl. Sci., N. Mex. State Univ., Las Cruces 88003] Elephant Butte Lake is a large warmwater impoundment of the Rio Grande in southwestern New Mexico. Thirteen of 28 species of fish present are relatively abundant. Nine of the 13 species are game fishes; one is forage; and river carpsucker (/Carpiodes carpio/), smallmouth buffalo (/Ictiobus bubalus/), and carp (/Cyprinus carpio/) make up a large rough or commercial fish group. Buffalo were exploited heavily, carp lightly, and carpsucker were unexploited from 1963-1972. Estimates of live-weight biomass production were 22,400 kg of carpsucker in 1967, 311,850 kg of buffalo in 1966, and 49,500 kg of carp in 1969. Standing crops changed from 29,500 kg to 30,200 kg of carpsucker, 275,400 kg to 252,700 kg of buffalo, and 40,200 kg to 39,600 kg of carp during the year. Distribution of production among age groups is discussed in relation to exploitation rates and reproductive success of each species. Annual production cycles are discussed in terms of 0.1-yr time intervals.
Combined production of 9.03 g/m²/yr for total surface area and 12.53 g/m²/yr for shoals is within the range of production reported from 22 other waters, and combined production of 0.93 kg/1,000 m²/yr is between production reported from two other waters. Production is discussed in terms of high insolation rates of 523-540 g-cal/cm²/day compared to less insolation where other estimates were made and in terms of pH and concentrations of hardness salts and nutrients in Elephant Butte Lake.

76-000678 Lett, P. F.; Kohler, A. C. RECRUITMENT: A PROBLEM OF MULTISPECIES INTERACTION AND ENVIRONMENTAL PERTURBATIONS, WITH SPECIAL REFERENCE TO GULF OF ST. LAWRENCE ATLANTIC HERRING (/CLUPEA HARENGUS HARENGUS/). J. Fish. Res. Board Can. 33 (6): 1353-1371. June 1976. In English with French summ. SFA 21(2).
[Fish. Mar. Serv., Biol. Stn., St. Andrews, NB E0G 2X0, Canada] A stochastic model was developed to study effects of temperature perturbations, predation, and competition from Atlantic mackerel (/Scomber scombrus/) on the recruitment process for Gulf of St. Lawrence Atlantic herring (/Clupea harengus harengus/). Multivariate statistics were used to determine the structural equation for portions of the life history of herring. Temperature and the abundance of age-group 0 mackerel affected the herring growth rate, but neither total herring biomass nor total pelagic biomass had any measurable effect on herring growth rate. Herring growth rate, coupled with adult stock size and environmental effects, mediated through temperature were the

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prime determinants of larval abundance less than 10 mm. Density-dependent growth was found in the /1/(1) stage but is argued as being anomalous in relation to age-group 0 herring maximizing their production to simultaneously stabilize both /1/(1) (the 1st yr of life) and year-class size. Predation, tempered by available food density, is discussed as a major population stabilizing and a fine-tuning mechanism for year-class formation. The ramifications of variation in recruitment are discussed in relation to the Beverton and Holt and the Schaefer models. In addition, the Ricker recruitment curve is confirmed as being a viable fisheries management tool.

76-000679 Nikol'skiy, G. V.; Shubnikova, N. G. THE NATURE OF THE INTERRELATIONSHIP BETWEEN ABUNDANCE AND CERTAIN BIOLOGICAL CHARACTERISTICS IN A POPULATION OF THE CRUCIAN CARP (/CARASSIUS CARASSIUS/). J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (4): 496-502. 1974. SFA 21(2).
[Biol. Fac., Moscow Univ., Moscow, USSR] An analysis has been made of the interrelationship between changes in the abundance of a population of the crucian carp (/Carassius carassius/) in relation to length, weight and condition factor and the variability of some external characters. The observations were carried out over a period of 12 years, between 1961 and 1972. A definite relationship was established between changes in the abundance and biomass of the population and changes in growth and condition and in the variability of morphological characters.

76-000680 Votinov, N. P.; Kas'yanov, V. P. THE STATE OF STOCKS OF THE STURGEON [/ACIPENSER BAERI/] IN SIBERIAN RIVERS AND MEASURES TO INCREASE THEIR ABUNDANCE. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (5): 689-698. 1974. SFA 21(2).
Consideration is given to the present state of stocks of the sturgeon (/Acipenser baeri/) in the Ob'-Irtysh basin and the Yenisey and Lena rivers and to measures for their increase.

SPAWNING HABITS AND MOVEMENTS, FECUNDITY, ETC.

76-000681 Ali, A. M. FECUNDITY AND HISTOLCGICAL DESCRIPTION OF THE GONADS OF THE FEMALE ASP (/ASPIUS ASPIUS/). J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (6): 896-904. 1974. SFA 21(2).
[Astrakhan Fish. Fish Ind. Tech. Inst., Astrakhan, USSR] Consideration is given to the pattern of the alteration in the fecundity of the asp (/Aspius aspius/) in the lower reaches and delta of the Volga in connection with variability in age, length and body weight. Relative fecundity is more related to age than to weight and body length. Data are given on the maturity stages of asp gonads between April and October 1971.

76-000682 Altukhov, K. A.; Yerastova, V. M. REPRODUCTION OF THE SMELT (/OSMERUS EPERLANUS/) AND THE ECOLOGY OF ITS EARLY DEVELOPMENT STAGES IN KANDALAKSHA BAY, WHITE SEA. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (6): 877-886. 1974. SFA 21(2).
[Ukr. Fish Res. Inst., Zaporozhe, USSR] An account is given of the conditions and time of the spawning run of the smelt (/Osmerus eperlanus/) into the Chernaya River. Data are given on fecundity, the duration of egg development at different temperatures and under different conditions, and the time of hatching of the larvae.

76-000683 Carscadden, J. E. STUDIES ON THE AMERICAN SHAD (/ALOSA SAPIDISSIMA/, WILSON) IN THE ST. JOHN RIVER AND MIRAMICHI RIVER, NEW BRUNSWICK WITH SPECIAL REFERENCE TO HOMING AND R-K SELECTION. Ph.D. dissertation, McGill Univ. 1975. [Order microfiche copy from the National Library of Canada at Ottawa.] From Diss. Abstr. Int. B Sci. Eng. 36(10), 1976. SFA 21(2).

Results of studies of biochemical, meristic and reproductive characteristics of these populations suggests that homing to natal tributaries occurs in this species and that this homing is as precise as homing to a major river system. Consistent differences in mean age at maturity, fecundity and frequency of repeat spawning between populations were also observed. In comparing the reproductive characteristics of the shad populations spawning in New Brunswick rivers with other Atlantic coast stocks previously studied, it was found that the geographical cline of reproductive characteristics (age at maturity and proportion of repeat spawners increased and fecundity decreased with increasing latitude) continued into the northern portion of the range. This trend indicates northern shad populations have reproductive characteristics typical of K-strategists while southern shad populations have reproductive characteristics typical of r-strategists. This pattern is opposite to that generally described for other species and contrary to the prevailing theory of the relation of r-K selection to latitude. A review of the literature suggests that this pattern is common but not universal in fish. Density-independent adult mortality during the spawning migration appears to be the major factor determining life-history strategies in shad. The literature suggests that in other species of fish, mortality of immatures is the primary factor influencing life-history strategies. In most species of fish, the presence of repeat spawners is common in northern latitudes no matter what stage in the life cycle the most important mortality occurs. The presence of repeat spawners in northern latitudes is apparently an adaptation to convey stability to populations inhabiting uncertain environments. --From abstr.

76-000684 Chernyayev, Zh. A. MORPHOLOGICAL AND ECOLOGICAL FEATURES OF THE REPRODUCTION AND DEVELOPMENT OF THE "BIG GOLOMYANKA" OR BAIKAL OIL-FISH (/COMEPHORUS BAICALENSIS/). J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (6): 856-868. 1974. SFA 21(2).

[IDMEZh, USSR Acad. Sci., Moscow, USSR] Consideration is given to the structural characteristics of the genitalia of males and females of a viviparous fish from Baikal, the big oil-fish (/Comephorus baicalensis/). The morphogenesis of embryonic development is described from the commencement of cleavage of the embryo until the hatching of the larvae and their release from the body of the female. A hypothesis is put forward concerning the mechanisms of the fertilization of oil-fish eggs in the stroma of the gonads. The time of maturation of the gonads, the mating periods of the breeding fishes, the duration of intra-uterine care and the release of the larvae are compared with the ecological features of Lake Baikal.

76-000685 Chittenden, M. E., Jr. PRESENT AND HISTORICAL SPAWNING GROUNDS AND NURSERIES OF AMERICAN SHAD, /ALOSA SAPIDISSIMA/, IN THE DELAWARE RIVER. NOAA Fish. Bull. 74 (2): 343-352. Apr. 1976. SFA 21(2).

[Dep. Wildl. Fish. Sci., Texas A&M Univ., College Station 77843] Spawning occurs from late May into July but mainly in a 3-wk period from late May to mid-late June. Spawning ends progressively later proceeding upstream. Light intensity seemed to regulate when spawning began each day. Fish selected shallow riffle areas in preference to pool habitat for spawning. Spawning behavior is described.

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Except for the most grossly polluted tidal water, spawning and nursery areas now extend throughout fresh water of the main Delaware and into the East and West branches. The most important spawning grounds and nurseries are now located from Port Jervis, N.Y., to Hancock, N.Y., and extend into the lower East Branch; this has probably been the case since 1910-20. There has been a fundamental upstream shift in the chief spawning grounds and nurseries since the decline of the Delaware River shad runs, because these historically extended downstream from about Delaware Water Gap, Pa., and included tidal water. Reasons for this shift suggest intrastream homing.

Only a small proportion of the historical nursery now contributes to production. Nursery and spawning areas now contribute to production of adults in proportion to their distance from Philadelphia, Pa. The extent of the spawning and nursery area since about 1910-20 has probably expanded and contracted around a core area in the upper Delaware near Hancock. Future prospects of Delaware River shad are discussed. They depend upon water quality in the tidal area and the proposed Tocks Island dam. Extirpation of the remnant runs is a distinct possibility.

76-000686 Cooper, J. C.; Hasler, A. D. ELECTROPHYSIOLOGICAL STUDIES OF MORPHOLINE-IMPRINTED COHO SALMON (/ONCORHYNCHUS KISUTCH/) AND RAINBOW TROUT (/SALMO GAIRDNERI/). J. Fish. Res. Board Can. 33 (4,1): 688-694. Apr. 1976. In English with French summ. SFA 21(2).

[Lab. Limnol., Univ. Wis., Madison 53706] Two groups of coho salmon (/Oncorhynchus kisutch/) were exposed to a 5 X $10^{-5}$ mg/liter concentration of a synthetic chemical, morpholine, for 4 wk during the smolting period, while two corresponding groups were left unexposed (controls). All groups were marked by finclipping and stocked into Lake Michigan near the mouth of Oak Creek (South Milwaukee, Wisconsin).

A second series of exposed and unexposed salmon was released 13 km north of Oak Creek. Rainbow trout (/Salmo gairdneri/) were tested in a similar experiment.

Homing salmonids were censused and then used in physiological experiments. Electroencephalographic studies showed significantly greater responses by the experimental (exposed) compared to control fish to 1 percent morpholine ($P \leq 0.001$-$0.05$) and by one paired group to a stream sample scented with morpholine (about $10^{-3}$ mg/liter morpholine $P \leq 0.01$). Responses to morpholine were specific in that another chemical similar to it did not elicit responses. These data support the olfactory hypothesis that salmon may imprint to naturally occurring homestream odors in the same way as they do to morpholine.

76-000687 Cooper, J. C.; Scholz, A. T.; Horrall, R. M.; Hasler, A. D.; Madison, D. M. EXPERIMENTAL CONFIRMATION OF THE OLFACTORY HYPOTHESIS WITH HOMING, ARTIFICIALLY IMPRINTED COHO SALMON (/ONCORHYNCHUS KISUTCH/). J. Fish. Res. Board Can. 33 (4,1): 703-710. Apr. 1976. In English with French summ. SFA 21(2).

[Lab. Limnol., Univ. Wis., Madison 53706] Tc test the olfactory hypothesis of salmon homing, fingerling coho salmon (/Oncorhynchus kisutch/) were exposed to low concentrations of an odorous synthetic chemical, morpholine, during presmolt and smolting periods. Equal numbers of these fish were not exposed (controls). Both groups were stocked directly into Lake Michigan near Oak Creek, South Milwaukee, Wisconsin. Another paired group of exposed and unexposed fish was released 13 km north of Oak Creek. During the adult spawning migration 18 mo later, morpholine was dripped into Oak Creek and the returning salmon were censused.

For four experiments over 2 consecutive yr, the number of exposed and unexposed fish captured at the artificially scented stream were, 216 vs. 28, 437 vs. 49, 647 vs. 65, and 439 vs. 55. These differences

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were highly significant (P less than .001).
During the 3rd yr, morpholine was not added to the stream during the spawning migration and exposed and nonexposed fish returned in equal, low numbers (51 vs. 55, P greater than .05). These results confirm the existence of odor imprinting and long-term olfactory memory in coho salmon. It is possible that this mechanism is also used in the natural imprinting situation.

76-000688 Cooper, J. C.; Scholz, A. T. HOMING OF ARTIFICIALLY IMPRINTED STEELHEAD (RAINBOW) TROUT, /SALMO GAIRDNERI/. J. Fish. Res. Board Can. 33 (4,1): 826-829. Apr. 1976. In English with French summ. SFA 21(2).
[Lab. Limnol., Univ. Wis., Madison 53706] Greater numbers of rainbow trout (/Salmo gairdneri/) exposed to morpholine as fingerlings as compared to trout left unexposed to morpholine as fingerlings homed to a stream scented with this odor (174 vs. 16). In order to locate this stream, the imprinted fish are able to search a distance of at least 13 km. These data support the olfactory hypothesis of homing.

76-000689 Hubbs, C. THE DIEL REPRODUCTIVE PATTERN AND FECUNDITY OF /MENIDIA AUDENS/. Copeia 1976 (2): 386-388. May 1976. SFA 21(2).
[Dep. Zool., Univ. Texas, Austin 78712] Female Mississippi silversides lay eggs each morning during June and July. The daily dry weight investment in eggs is between 5.6 and 7.5 percent of the female's weight. Although males may produce volumes of sperm, the biomass invested in young is far less as each sperm is far smaller than each egg. Most of the testicular weight changes are water and the majority of the sperm do not fertilize eggs. --Concl. and discuss.

76-000690 Ivankov, V. I.; Ivankova, Z. G. FECUNDITY OF FLOUNDERS IN THE NORTHWESTERN SEA OF JAPAN. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (6): 868-876. 1974. SFA 21(2).
[TINRO, Vladivostock, USSR] The absolute fecundity (AF) of 8 species of flounder exhibits considerable variation in relation to population density and structure, and to selective fishing. At present, following lengthy exploitation, the AF of the flounders of Peter the Great Bay has declined considerably by comparison with the '30's. The relationship between body size and AF is expressed by different functions in different flounder species: exponential, asymptotic, logistic and linear. AF is shown to be related to the nature of spawning and spawning ecology.

76-000691 Keysner, E. E.; Tot, V. S.; Shilov, V. N. CHARACTERISTICS OF THE BEHAVIOR AND BIOLOGICAL CYCLES OF THE MARBLED /NOTOTHENIA/ (/NOTOTHENIA ROSSI/) IN RELATION TO BOTTOM TOPOGRAPHY, BOTTOM MATERIALS AND CURRENTS. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (4): 610-613. 1974. SFA 21(2).
[South. Basin Fish Locating Res. Fleet, Kerch, USSR]

76-000692 Kukuradze, A. M. A DESCRIPTION OF THE SPAWNING STOCK AND REPRODUCTION OF THE PIKE-PERCH [/LUCIOPERCA LUCIOPERCA/] OF THE DANUBE DELTA AND WATERS IN THE DANUBIAN REGION. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (3): 385-392. 1974. SFA 21(2).
[Azov Black Sea Res. Inst. Sea Fish. Oceanogr., Odessa, USSR] Information is given on a spawning population of the pike-perch [/Lucioperca lucioperca/]. The places and times of spawning, the nature of spawning and the dependence of spawning on conditions in the given body of water are described. Recommendations are made for the

76-000692 CONTINUED
restoration of pike-perch stocks in the Danube.

76-000693 Kutuzov, A. M. REPEATED SPAWNING OF THE WHITE BREAM (/BLICCA BJOERKNA/) IN SVIYAGA BAY OF KUYBYSHEV RESERVOIR. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (6): 887-890. 1974. SFA 21(2).
[Dep. Vertebr. Zool., Kazan Univ., USSR] Two spawning runs of the white bream (/Blicca bjoerkna/) have been established in Sviyaga Bay in Kuybyshev Reservoir. The second is due to the intermittent nature of the spawning of this fish. The fact of the intermittency of spawning is also confirmed by an analysis of data on the coefficient of maturity of females and on fecundity.

76-000694 Lear, W. H. MIGRATING ATLANTIC SALMON (/SALMO SALAR/) CAUGHT BY OTTER TRAWL ON THE NEWFOUNDLAND CONTINENTAL SHELF. J. Fish. Res. Board Can. 33 (5): 1202-1205. May 1976. In English with French summ. SFA 21(2).
[Fish. Mar. Serv., Res. Resour. Serv., St. John's, NF A1C 1A1, Canada] Fifty-four Atlantic salmon (/Salmo salar/) were reported from incidental catches of otter trawls on the continental shelf off Newfoundland during 1933-74. Fifty percent of the captures were taken along the southwest edge of the Grand Bank. On the basis of weights, 19 percent of the salmon were presumed to be 1-sea-winter salmon, 60 percent were 2-sea-winter salmon, 19 percent were 3-sea-winter salmon while 2 percent has previously spawned. It is postulated that the southwestern Grand Bank may form a winter-spring migration route for Atlantic salmon enroute to southern and western Newfoundland, the Maritime provinces, and Quebec.

76-000695 Lebedev, V. G. ECOLOGICAL CONDITIONING OF FECUNDITY OF THE LAKE KUBEN WHITEFISH /COREGONUS LAVARETUS NELMUSCHKA/. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (1): 50-55. 1975. SFA 21(2).
[Pedagog. Inst., Vologda, USSR] The fecundity of the freshwater lake-river whitefish /Coregonus lavaretus nelmuschka/ from Kuben Lake was studied. The relationship between absolute fecundity and temperature was demonstrated. The relative influence of temperature on growth and fecundity was established.

76-000696 Murawski, W. S.; White, R. L.; Festa, P. J. OVARY MATURATION IN THE SUMMER FLOUNDER /PARALICHTHYS DENTATUS/. N. J. Div. Fish Game Shellfish. Misc. Rep. no. 16M: 16p. Apr. 1976. SFA 21(2).
[N. J. Div. Fish. Game, Shellfish., Labor & Industry Bldg., Box 1390, Trenton 08625] From December 1961 through March of 1964, the ovaries of 2,852 summer flounder, /Paralichthys dentatus/, were examined. Four distinct egg types were characterized as to diameter and yolk development. The pre-spawning, ready to spawn, spent and immature ovary conditions were determined. The data indicates 370 mms. as minimum female spawning size with general female maturity occurring at a larger length, probably at age four. Correlation of ovary condition with date of capture indicates peak spawning activity occurs during October and November. Ovary weight/total body weight ratios were developed and related directly to egg type composition in the ovaries.

76-000697 Oyaveyer, E. A. THE FECUNDITY OF AUTUMN BALTIC HERRING (/CLUPEA HARENGUS MEMBRAS/) POPULATIONS IN THE NORTHEASTERN BALTIC. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (4): 552-560. 1974. SFA 21(2).

[Baltic Fish. Res. Inst., Tallin, USSR] An examination was made of 1135 specimens of the autumn Baltic herring collected between the end of June and the end of August from 4 regions of the Baltic. In the Northeastern Baltic the effect of age on fecundity is more appreciable in the more southerly populations of the autumn Baltic herring than in the more northerly ones. The effect of age on fecundity is statistically insignificant in the population of the Gulf of Finland.

76-000698 Partridge, B. L.; Liley, N. R.; Stacey, N. E. THE ROLE OF PHEROMONES IN THE SEXUAL BEHAVIOUR OF THE GOLDFISH. Anim. Behav. 1976 (2): 291-299. May 1976. SFA 21(2).

[Dep. Exp. Psychol., Univ. Oxford, Oxford, England] Male goldfish (/Carassius auratus/) discriminate between ovulated and unovulated females on the basis of chemical cues. Goldfish males made temporarily anosmic by occlusion of the nares, or permanently anosmic by section of the olfactory nerves showed a marked decrease in sexual behaviour. Perference tests in a Y-maze indicate that the pheromone is present in the ovarian fluid of an ovulated female. It is concluded that shortly after ovulation the female goldfish releases a pheromone from the ovary which attracts the male and elicits the persistent courtship that accompanies spawning.

76-000699 Ross, M. R. NEST-ENTRY BEHAVIOR OF FEMALE CREEK CHUBS (/SEMOTILUS ATROMACULATUS/) IN DIFFERENT HABITATS. Copeia 1976 (2): 378-380. May 1976. SFA 21(2).

[Dep. For. Wildl. Manage., Univ. Mass., Amherst 01002]

76-000700 Savvaitova, K. A.; Mina, M. V.; Maksimov, V. A. EVOLUTIONARY ASPECTS OF THE REPRODUCTIVE ECOLOGY OF TROUT OF THE GENUS /SALMO/ IN KAMCHATKA. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (1): 18-27. 1975. SFA 21(2).

[Dep. Ichthyol., Moscow State Univ., Moscow, USSR] The similarity of the reproductive ecology of the Kamchatka trout and the freshwater mykiss notwithstanding, each population has specific features which have developed as an adaptation to conditions of existence in given environments. The absence of the freshwater mykiss in the small rivers of the west coast of Kamchatka is explained by inadequate food in these rivers, and the absence of the diadromous form in the River Kamchatka basin by the lack of suitable spawning grounds. The reduction in numbers and the accompanying curtailment of the migrations during the emergence of the freshwater form of /S. mykiss/ from the diadromous form is probably determined in the first place by the nature of the selection pressure in the spawning grounds. The "freshwater" and "diadromous" forms represent the conditioned association of variants of a continuous evolutionary-ecological series.

76-000701 Scholz, A. T.; Horrall, R. M.; Cooper, J. C.; Hasler, A. D. IMPRINTING TO CHEMICAL CUES: THE BASIS FOR HOME STREAM SELECTION IN SALMON. Science 192 (4245): 1247-1249. 18 June 1976. SFA 21(2).
[Dep. Zool., Lab. Limnol., Univ. Wis., Madison 53706] Juvenile coh salmon were exposed to morpholine or phenethyl alcohol (p-alcohol) fo 1 1/2 months and then released in Lake Michigan. During the spawning migration 18 months later, morpholine and p-alcohol were metered into separate streams, and the number of morpholine- and p-alcohol-exposed fish returning to each stream was determined. Seventeen other locations were also monitored. The majority of the fish exposed to morpholine were captured in the stream scented with morpholine and most fish exposed to p-alcohol were captured at the p-alcohol-treated stream. This field study demonstrates that coho salmon imprint to and utilize chemical cues for homing.

76-000702 Seid-Bzayev, M. M.; Alekperov, A. P. SOME DATA ON THE DEVELOPMENT CYCLE OF THE GONADS OF THE CASPIAN ROACH (/RUTILUS RUTILUS CASPICUS/) OF THE URAL RIVER. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (6): 989-992. 1974. SFA 21(2).
[Inst. Zool., Az. SSR Acad. Sci., USSR] The Caspian roach of the Ural River is a fish that is not an intermittent spawner and that has synchronous growth of the oocytes. A single group of oocytes in an identical development phase develops in the female ovary toward the spawning period. Having spawned in the spring, Caspian roach spawners migrate to the sea, where they mature once again, and toward the autumn, on reaching maturity stage III, they enter the river mouth, where they lie up in pools. Which fish will spawn in the spring of the following year may be determined in the sea during the summer. --From concl.

76-000703 Serobaba, I. I. SPAWNING ECOLOGY OF THE WALLEYE POLLOCK (/THERAGRA CHALCOGRAMMA/) IN THE BERRING SEA. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (4): 544-552. 1974. SFA 21(2).
[Pacific Res. Inst. Sea Fish. Oceanogr., Vladivostok, USSR] Data are given concerning the spawning conditions and the distribution pattern of spawners, juveniles, fingerlings, larvae and eggs of the walleye pollock (/Theragra chalcogramma/) in the Bering Sea. It is shown that spawning in clearly segregated water layers and all examples of the vertical localization of adult walleye pollock and of eggs and larvae are of an adaptive nature, promoting the survival of the individual and the preservation of the species as a whole.

76-000704 Stauffer, T. M. FECUNDITY OF COHO SALMON (/ONCORHYNCHUS KISUTCH/) FROM THE GREAT LAKES AND A COMPARISON WITH OCEAN SALMON. J. Fish. Res. Board Can. 33 (5): 1150-1155. May 1976. In English with French summ. SFA 21(2).
[Mich. Dep. Nat. Resour., Marquette Fish. Res. Stn., Marquette 49855] I measured fecundity of coho salmon (/Oncorhynchus kisutch/) that matured in the Great Lakes to make comparisons with Pacific Ocean coho salmon and among groups of Great Lakes salmon. Numbers of eggs produced (1600-3500) by Great Lakes salmon were comparable to production (1500-3300) by Pacific salmon of similar size. Average egg diameters of Lake Michigan (7.1-7.4 mm) and Pacific salmon (6.1-7.4 mm) were also comparable but Lake Superior eggs were smaller (5.1-5.4 mm). Fecundity of second generation freshwater salmon which originated from Lake Michigan eggs was similar to that of the first generation which originated from Pacific eggs because the average numbers (2938-3243) and diameters (7.1-7.4 mm) of eggs produced were about the same. On the average, Lake Michigan salmon contained more (2938) and larger (7.1-mm diam) eggs than did Lake Superior salmon (2150 and 5.1-mm

76-000704 CONTINUED
diam) of the same year-class and early life history.

76-000705 Timoshek, N. G.; Shilenkova, A. K. THE NATURE OF THE OOGENESIS AND SPAWNING OF BLACK SEA MULLET. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (5): 727-734. 1974. SFA 21(2).
[AzCherNIRO, Kerch, USSR] It has been established that the process of oogenesis is similar in three mullet species (/Mugil cephalus/, /M. saliens/ and /M. auratus/) and proceeds synchronously in all parts of the ovaries. The simultaneous maturation of these fishes and their spawning within a short period quite close to the shores are predetermined by the occurrence in inshore waters of the overwhelming majority of females in maturity stage IV, in whose ovaries oocytes in the trophoplasmic growth stage, in the phase of intensive yolk accumulation, predominate, as well as by the low fatness and prolonged fasting of these females due to the separation of the spawning and feeding grounds.

76-000706 Turner, J. L. STRIPED BASS SPAWNING IN THE SACRAMENTO AND SAN JOAQUIN RIVERS IN CENTRAL CALIFORNIA FROM 1963 TO 1972. Calif. Fish Game 62 (2): 106-118. Apr. 1976. SFA 21(2).
[Box 27, Monkey Bay, Malawi, Africa] Striped bass eggs and larvae were collected in the Sacramento and San Joaquin Rivers during spawning surveys from 1963 to 1972. Spawning was heaviest at water temperatures from 17.2 to 20C. Most spawning in the San Joaquin Delta occurred from April 23, to May 25. Spawning in the Sacramento River above the Delta was primarily from May 10 to June 12. The middle of the spawning period in the Delta averaged 15 days earlier than in the Sacramento River. The time difference was greatest in years of high flow. Most spawning in the Sacramento River occurred from the City of Sacramento upstream to Colusa. Most spawning in the Sacramento-San Joaquin Delta occurred between Antioch and Venice Island where salinities during spawning have usually been less than 200 mg/l TDS but occasionally have been up to 1,500 mg/l. Both eggs and larvae were more concentrated near the bottom than at the surface in the Sacramento River above the Delta. The survey in 1972 indicated almost all larvae in the Sacramento River upstream from Isleton are 6 mm or less in length. In 1972 about 55 percent of the season's spawning occurred in the Sacramento River.

76-000707 Yevseyenko, S. A. NEW DATA CONCERNING EEL EGGS ON GEORGES BANK. J. Ichthyol. (Engl. Transl. Vopr. Ikhticl.) 14 (2): 294-298. 1974. SFA 21(2).
[VNIRO, Moscow, USSR]

MOVEMENTS, SEASONAL AND DEPTH DISTRIBUTION, ETC.

76-000708 Hess, L. THE EFFECT OF ARTIFICIAL HYPOLIMNION AERATION ON THE DEPTH DISTRIBUTION AND CATCH RATE OF RAINBOW TROUT. Proc. W. Va. Acad. Sci. 48 (1): 22. 1976. Abstract only. SFA 21(2).
[W.Va. Dep. Nat. Resour., P.O. Box 67, Elkins 26241] Artificial hypolimnion aeration was undertaken in Spruce Knob Lake in 1974 and 1975 to improve summer trout fishing. Mechanical aeration during 1975 raised dissolved oxygen concentrations higher and caused less change in temperature regimes, but circulated less water than did compressed air aeration in 1974. Significantly greater numbers of trout were found in hypolimnetic waters in July during aeration years. Vertical distribution of trout during June showed less change during aeration

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because surface temperatures and bottom oxygen concentrations were similar to pre-aeration levels. Vertical distribution of trout during August was similar to that found before aeration because aeration equipment was unable to maintain satisfactory hypolimnetic dissolved oxygen concentrations. Pre-aeration creel data indicated that trout catch rates decreased from an average January-May catch rate of 0.34 trout/hr to 0.13 trout/hr in July-August. Compressed air aeration in 1974 did not significantly change the summer catch rates, apparently because of unsatisfactory hypolimnetic water quality, but mechanical aeration in 1975 increased July-August catch rates about four times over those observed before aeration to an average of 0.11 trout/hr. In June 1975 catch rates were good for both boat and shore anglers while during the July-August period boat anglers success rates were 2.5 times higher than shore anglers.

76-000709 Jessop, B. M. DISTRIBUTION AND TIMING OF TAG RECOVERIES FROM NATIVE AND NONNATIVE ATLANTIC SALMON (/SALMO SALAR/) RELEASED INTO BIG SALMON RIVER, NEW BRUNSWICK. J. Fish. Res. Board Can. 33 (4,1): 829-833. Apr. 1976. In English with French summ. SFA 21(2).
[Fish. Mar. Serv., Resour. Dev. Br., Halifax, NS, Canada] Recaptures of tagged Atlantic salmon (/Salmo salar/) released as smolts into the Big Salmon River varied between annual releases with no differences found on the basis of native or nonnative origin. Few were recaptured outside the Bay of Fundy. Distant fisheries in Greenland and Newfoundland take few salmon from Big Salmon River and commercial exploitation within the Bay of Fundy is minor, particularly by the former large fishery off the mouth of the Saint John River.

76-000710 Markle, D. F. THE SEASONALITY OF AVAILABILITY AND MOVEMENTS OF FISHES IN THE CHANNEL OF THE YORK RIVER, VIRGINIA. Chesapeake Sci. 17 (1): 50-55. Mar. 1976. SFA 21(2).
[Va. Inst. Mar. Sci., Gloucester Point 23062] Monthly trawl collections from a 5-year period (1967-1971) were analyzed to determine the distribution of fishes in the channel of the Chesapeake-York-Pamunkey estuary. The relative availability of twelve major species showed spatial and temporal interspecific differences. In winter four resident species, /M. saxatilis/, /M. americana/, /I. catus/ and /I. punctatus/ were most abundant. In the spring and fall several resident and nonresident species were abundant, while in summer only two nonresident species, /C. regalis/ and /L. xanthurus/, and one resident species, /O. tau/, were abundant in the channel. The combined effect of different distribution patterns was that total numbers of individuals and species increased in spring, declined in summer, and reached their greatest magnitude in fall.

76-000711 Poddubnyy, A. G.; Malinin, L. K.; Svirskiy, A. M. BEHAVIOR OF THE SEVRYUGA [/ACIPENSER STELLATUS/] BELOW FEDEROVSKAYA DAM ON THE KUBAN RIVER. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (5): 776-783. 1974. SFA 21(2).
[USSR Acad. Sci., Borok, Yaroslavl Province, USSR] Telemetric observations on the movements of tagged sevryuga (/Acipenser stellatus/) have shown that the approach paths of the fish to the zone around the Federovskaya dam and the places where they concentrate change annually. An analysis has been made of the paths and rates of movement of the fish in relation to the regime of water discharge through the dam complex.

76-000712 Rainwater, C. L. AN ECOLOGICAL STUDY OF MIDWATER FISHES IN SANTA CATALINA BASIN, OFF SOUTHERN CALIFORNIA, USING CLUSTER ANALYSIS. Ph.D. dissertation, Univ. South. Calif. 1975. From Diss. Abstr. Int. B Sci. Eng. 36(11), 1976. SFA 21(2).

Ecological studies of midwater fishes in Santa Catalina Basin were accomplished using computer-aided cluster analyses of abundance data for fishes taken from opening and closing midwater trawls in Santa Cataline Basin between 200 and 800 meters. A total of 56 species of midwater fishes were taken in the trawl samples. Of these, 27 species chosen for frequency of occurrence and distinct bathymetric distributions were used in detained faunal analyses. Seven Species Groups or associations were designated: Group 1, containing /Cyclothone signata/, /Stenobrachius leucopsarus/, /Tarletonbeania crenularis/, /Argyropelecus affinis/ and /Diaphus theta/; Group 2, containing /Stomias atriventer/, /Leuroglossus stilbius stilbius/, /Triphoturus mexicanus/, /Lampanyctus ritteri/, and /Idiacanthus antrostomus/; Group 3, containing /Holtbyrnia/ spp., /Sternoptyx obscura/, /Cyclothone acclinidens/, and /Bathylagus wesethi/; Group 4, containing /Poromitra crassiceps/, /Melanostigma pammelas/, /Alepocephalus/ spp., and /Cyclothone pallida/; Group 5, containing /Argyropelecus sladeni/, /Protomyctophum crockeri/, /Lampanyctus regalis/, and /Symbolophorus californiensis/; Group 6, containing /Sagamichthys abei/ and /Chauliodus macouni/; and Group 7, containing /Scopelogadus mizolepis bispinosus/, /Parvilux ingens/, and /Melamphaes lugubris/.

Bray-Curtis Dissimilarity Indices for all pairs of 151 trawls were calculated using abundance data transformed to the square root. Cluster analysis produced 11 groups designated Site Groups A through K. The relative species composition which determined the dissimiliarities among trawls were apparently related to the abiotic environmental factors associated with each trawl (trawl depth, temperature, salinity, oxygen concentration, and day or night). The 11 Site Groups form three larger groups which were referred to as shallow-water, upper mesopelagic regime (200-350m), containing Site Groups A through E; a middle-depth, lower mesopelagic regime (350-550m), containing Site Groups F through I; and a deep-water, bathypelagic regime (550-800m), containing Site Groups J and K. Each regime had characteristic values for temperature, salinity, and oxygen concentration. The midwaters of Santa Catalina Basin can be viewed as a dynamic intergrading system of three regimes with characteristic species associations. --From abstr.

76-000713 Trujillo, H. DISTRIBUCION DE LA SARDINA (/SARDINELLA ANCHOVIA/) SEGUN RESULTADOS DE LAS PROSPECCIONES AREAS REALIZADAS EN EL ORENTE VENEZOLANO ENERO-MAYO 1975. [DISTRUBITION OF THE SARDINE (/SARDINELLA ANCHOVIA/) ACCORDING TO RESULTS OF AERIAL SURVEYS IN EASTERN VENEZUELA JANUARY-MAY 1975.] Venez. Minist. Agric. Cria Inf. Tech. no. 66. 28p. 1976. In Spanish with English summ. SFA 21(2).

[Minist. Agric. Cria, Of. Nac. Pesca, Caracas, Venezuela] This paper is a study of the distribution of sardine (/Sardinella anchovia/) as observed from aerial surveys.

During the study period a large area was surveyed and it was found that sardines were distributed mostly in coastal zones, whereas the same species was not found in offshore waters, as recorded from visual aerial observations.

It seems that such behaviour is associated with the trade winds as follows: during the windy season, mature specimens of sardine, which constitute most of the commercial catches, are heavily concentrated in coastal areas, whereas larvae and juveniles favor the relatively quiet waters of Mochima Bay-Puerto La Cruz area.

76-000714 Turuk, T. N. FATNESS AND VERTICAL MIGRATIONS OF THE ATLANTIC COD (/GADUS MORHUA MORHUA/). J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (6): 977-982. 1974. SFA 21(2).
[PINO, Murmansk, USSR] Consideration is given to the relationship between fatness and the vertical migrations of the Atlantic cod (/Gadus morhua morhua/). "Fatness" was defined as the weight of the liver expressed as a percentage of the total weight of the fish. A positive correlation is established between fatness and bottom trawl cod catches. Cod with the minimum fat reserves most often make regular daily vertical migrations. Aggregations of well-nourished fish are more stable.

76-000715 Wohlschlag, D. E. DISTRIBUTION AND ABUNDANCE OF SOUTH TEXAS OUTER CONTINENTAL SHELF BENTHIC FISHES. Presented at the 39th Annu. Meeting, Am. Soc. Limnol. Oceanogr., Savannah, Ga., June 21-24, 1976. f1976. SFA 21(2).
[Univ. Texas Mar. Sci. Inst., Port Aransas] A one-year controlled sampling of benthic fishes provides data for evaluating distribution and abundance by means of various diversity and evenness indices. Comparisons among 72 samples between day and night, over 4 transects with 3 stations each, and over 3 seasons, revealed that indices and rarefaction curves are useful in a gross, empirical way to detect inshore-offshore, north-south, and seasonal distribution-abundance patterns. Some low-high ranges are: individuals, 9-2199: biomass, 0.4-21.6 kg; species, 5-32; Shannon-Weaver "H", 0.583-3.738; equitability, 0.086-0.0800; Hurlbert PIE, 0.186-0.952; and others. Sampling variability is a major problem. By ANOVA and regressions, indices can be roughly related to physical-chemical substrate properties and to each other. In no cases are indices as informative as numerical and ponderal species lists for explanations of unusual species association.

FOODS AND FEEDING

76-000716 Borodulina, O. D. THE FEEDING OF THE BIGEYE TUNA [/THUNNUS OBESUS/] IN THE GULF OF GUINEA AND ITS PLACE IN THE TROPHIC SYSTEM OF THE PELAGIC ZONE. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (5): 765-775. 1974. SFA 21(2).
[IOAN, Moscow, USSR] An investigation was made of the contents of 143 stomachs of the bigeye tuna (/Thunnus obesus/) from the oceanic and coastal parts of the Gulf of Guinea. Food items were represented by crustaceans (approximately 20 species of 4 orders), cephalopods (30 species from 16 families) and fishes (38 species from 23 families). A difference is noted in the feeding of neritic and oceanic tuna. It is established that the bigeye tuna feeds basically on epimesopelagic and mesopelagic species of fishes and squids. Fishes play the principal role in terms of weight, with cephalopods in second place; the weight of other invertebrates is insignificant.

76-000717 Brook, I. M. TROPHIC RELATIONSHIPS IN A /THALASSIA/ COMMUNITY: FISH DIETS IN RELATION TO BENTHIC ABUNDANCE AND BIOMASS. Presented at the 39th Annu. Meeting, Am. Soc. Limnol. Oceanogr., Savannah, Ga., June 21-24, 1976. 1976. SFA 21(2).
[Univ. Miami, Miami, FL 33149] Digestive tract analysis of the ten most abundant fishes captured during a twelve month sampling period by a drop net quadrat showed that the peracaridean crustaceans and the polychaetes provided the principal connections between the benthic community and higher trophic levels. Mollusks were not a preferred

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food item of the fishes examined. Although blade density in the study area was more than 5000/m² and primary productivity (leaves alone) was estimated 3.7 g dry/m²/day, the maximum number of benthic and cryptic organisms retained by a 1 mm screen was 1895, with a dry weight equivalent of 3.35 g/m². The majority of fishes captured were foragers over a wider area than the 360 m² quadrat enclosed by the drop net. The most common resident fishes were the /Syngnathus scovelli/, /S. floridae/ and the goldspotted killifish, /Floridichthys carpio/. However, the population of resident predators was low and limited by the small standing stock of polychaetes and peracaridean crustaceans (1.97 g dry/m², maximum). The more common fishes did not use /Thalassia/ detritus as a food source or supplement.

76-000718 Budnichenko, V. A. THE FEEDING OF /SAURIDA UNDOSQUAMIS/ AND /SAURIDA TUMBIL/ (SYNODONTIDAE) ALONG THE OMAN COAST. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (2): 267-272. 1974. SFA 21(2).
[Azcher NIRO, Kerch, USSR] Data are given on the composition of the food of /Saurida undosquamis/ and /Saurida tumbil/ in the summer and winter. Consideration is given to the characteristics of the feeding of /S. undosquamis/ at different depths and in the course of 24 hours.

76-000719 Carlson, H. R. FOODS OF JUVENILE SOCKEYE SALMON, /ONCORHYNCHUS NERKA/, IN THE INSHORE COASTAL WATERS OF BRISTOL BAY, ALASKA, 1966-67. NOAA Fish. Bull. 74 (2): 458-462. Apr. 1976. SFA 21(2).
[NMFS, P.O. Box 155, Auke Bay, AK 99821] The foods consumed by seaward-migrating sockeye salmon in Bristol Bay vaired in the relative proportion and occurrence of kinds and quantities between months during the summer. In early June 1966 in the Kvichak area, fish and insects made up 97 percent of the bulk (weight). Fish occurred in 5 percent of the stomachs and insects in 53 percent. By late June most of the food was copepods. In mid-June of the fcllowing year (1967), fish, insects, and copepods made up 93 percent of the bulk; fish occurred in 19 percent of the stomachs, insects in 76 percent, and copepods in 62 percent. In mid-June 1966, fish collected farther seaward at Egegik contained very small amounts of food consisting of euphausiids and miscellaneous crustaceans. In mid-July 1966 at Ugashik, all fish contained larval crustaceans. Copepods were insignificant in terms of bulk but occurred in 70 percent of the stomachs. At Port Heiden (farther seaward) on the same date, fish made up 76 percent of the bulk of the stomach contents, occurring in 28 percent of the fish, whereas amphipods occurred in 71 percent and insects in 57 percent. At Port Moller in lower Bristol Bay throughout July and on 1 August 1967, copepods made up 71 percent of the bulk of food and occurred in 85 percent of the fish. As the young sockeye salmon migrated seaward over successive months, they ate increasing amounts of food. In terms of both bulk and frequency of occurrence, copepods were the most important food of juvenile sockeye salmon in inshore Bristol Bay in 1966 and 1967. Fish were second in importance. The difference observed in food eaten over successive months can be largely attributed to food availability. --From results and discussion

76-000720 Daugherty, C. H.; Daugherty, L. B.; Blair, A. P. VISUAL AND OLFACTORY STIMULI IN THE FEEDING BEHAVIOR OF DARTERS (/ETHEOSTOMA/) INHABITING CLEAR AND MUDDY WATER. Copeia 1976 (2): 380-382. May 1976. SFA 21(2).
[Dep. Zool., Univ. Mont., Missoula 59801]

76-000721 Drenner, R. W.; O'Brien, W. J. THE FEEDING RATE AND ELECTIVITY OF GIZZARD SHAD. Presented at the 39th Annu. Meeting, Am. Soc. Limnol. Oceanogr., Savannah, Ga., June 21-24, 1976. f1976. SFA 21(2).
[Univ. Kans., Lawrence 66044] The limnetic feeding rate of gizzard shad (/Dorosoma cepedianum/) was determined in the laboratory for both phytoplankton and zooplankton food items. Shad larger than 6.5 cm in total length did not visually select individual food items, but filter fed using exaggerated respiratory movements. Shad filtering rate, filtering efficiency, capture effectiveness and prey density determined feeding rate. Filtering rate was a function of buccal cavity volume and pumping rate. Buccal cavity volumes, which are an exponential function of shad length, ranged from 0.5 to 6.0 ml for shad 6.5 to 20 cm in length, respectively. Pumping rates above 150 pumps per minute created filtering rates up to 1.0 liter per minute. Shad electivities for zooplankton were determined by the relationship of prey escape speed to shad intake velocity. Shad had higher electivities for the slow cladocerans, /Bosmina/ and /Daphnia/, and low electivity for the fast copepod, /Diaptomus/. Because gizzard shad are the most abundant fish, their high omnivorous feeding rate has a significant impact on plankton of midwest reservoirs.

76-000722 Durbin, A. G.; Durbin, E. G. EFFECT OF GRAZING BY ATLANTIC MENHADEN, /BREVOORTIA TYRANNUS/, ON PLANKTON POPULATIONS OF A NEW ENGLAND ESTUARY. Presented at the 39th Annu. Meeting, Am. Soc. Limnol. Oceanogr., Savannah, Ga., June 21-24, 1976. 1976. SFA 21(2)

[Grad. Sch. Oceanogr., Univ. R.I., Kingston 02881] Predation by Atlantic menhaden may profoundly influence the abundance and species composition of the phytoplankton and zooplankton in Narragansett Bay, R.I. The daily ration of $4.5 \times 10^6$ kg of adult menhaden, a typical population biomass, has been calculated and combined with known filtering efficiencies of menhaden when feeding on different plankton species, and published information on the zooplankton and production and size-distribution of the phytoplankton in Narragansett Bay, in order to illustrate the potential grazing impact of these fish. This analysis indicated that because of the small size of the dominant phytoplankters during the summer, zooplankton rather than phytoplankton is the principal diet of adult menhaden in Narragansett Bay. Menhaden were found to reduce zooplankton in the Upper Bay to low levels within a few days, and as a result it is possible that the movements of the fish within the Bay and in and out of the Bay are related to food abundance. From an estimation of the capacity of Narragansett Bay to support menhaden, it was found that the Upper Bay was unable to support observed menhaden populations for more than a few days, and the calculated food ration of the fish represented up to 79 percent of the total potential secondary production of the Bay.

76-000723 Eggers, D. M.; Doble, B. D. SEASONAL PATTERNS OF PREY SELECTION BY PLANKTIVOROUS JUVENILE SOCKEYE SALMON, LONGFIN SMELT, AND THREESPINE STICKLEBACK IN LAKE WASHINGTON. Presented at the 39th Annu. Meeting, Am. Soc. Limnol. Oceanogr., Savannah, Ga., June 21-24, 1976. 1976. SFA 21(2).

[Univ. Wash., Seattle 98195] Samples of the three principal limnetic fish planktivore species in Lake Washington were taken during November 1974, February 1975, June 1975, August 975, and October 1975. The relative abundance and length frequency distributions of the respective zooplankton species found in the cardiac portion of the stomach were compared to that of zooplankton sampled with a high-speed plankton net towed in the depth strata where the fish were caught. All three planktivores show size-selective predation, both by species and size within species. The degree of prey selection increases as larger zooplankton forms become available in the spring and early summer, and decreased as the larger forms decline in abundance or disappear during the winter. Each of the three planktivores show within prey species size selection, particularly for the abundant smaller copepods /Cyclops/ and /Diaptomus/. Patterns of prey selection by sockeye, stickleback, and smelt less than 50 mm are similar. Smelt larger than 50 mm heavily exploit a very large (relative to other zooplankton forms present) mysid (/Neomysis awatchensis/). Neomysis is rarely taken by sockeye, stickleback, or small smelt. Smelt have a larger mouth gape, which may account for the observed difference in prey selection. The seasonal patterns of prey selection suggest that planktivorous fish in Lake Washington optimize foraging time by ignoring small prey when encountered.

76-000724 Girsa, I. I. THE DIURNAL RHYTHM IN THE FEEDING OF UNDERYEARLINGS OF SOME WHITE SEA FISH AT DIFFERENT PHOTOPERIODS. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (1): 102-110. 1975. SFA 21(2).

[IEMEZh, Moscow, USSR] The diurnal Rhythms in the feeding of herring, sand lance and three-spine stickleback underyearlings from the White Sea during the summer were studied. The reasons for the variation in feeding intensity (or variability of food items) during the day are considered. It was established that the time at which the larvae emerge from the egg, the transition to defensive behavior and the inaccessibility of food because of low light intensity are the main factors which determine the daily feeding rhythm of underyearlings. Horizontal migrations, which take place morning and evening play a substantial part in the behavior of herring underyearlings.

76-000725 Gorbunova, N. N.; Lipskaya, N. Ya. FEEDING OF LARVAE OF THE BLUE MARLIN, /MAKAIRA NIGRICANS/ (PISCES, ISTIOPHORIDAE). J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (1): 95-101. 1975. SFA 21(2).

[USSR Acad. Sci., VNIRO, Moscow, USSR] Blue marlin larvae of a length of 6 mm begin to feed on the larvae of pelagic fish as well as on zooplankton. When they have attained a length of 12 mm, they consume mainly fish larvae while zooplankton is found rarely. The main food components were: Mullidae, Exocoetidae, Ccryphaenidae and the young of their own species. Zooplankton was represented almost exclusively by Corycaeidae (/Farranula concinna/). The most intensive feeding occurred in the morning (7-10 a.m.) and in the evening (4-7 p.m.). The feeding rhythm coincided with the daily rhythm of occurrence of larvae in the near-surface water layer. The approximate size of the daily rations is equal to 40-50 percent of the body weight of blue marlin larvae of a length of 6 to 22 mm and weighing 9 to 130 mg. --From concl.

76-000726 Janssen, J. THE FEEDING BEHAVIOR REPERTOIRE OF THE ALEWIFE (/ALOSA PSEUDOHARENGUS/). Presented at the 39th Annu. Meeting, Am. Soc. Limnol. Oceanogr., Savannah, Ga., June 21-24, 1976. 1976. SFA 21(2).

[Univ. Wis., Milwaukee] Feeding behaviors of the alewife were observed in the laboratory. Four planktivory modes were found: 1. "Particulate feeding" in which the fish approaches prey from beneath, tips the head up, and sucks the prey in. 2. "Darting" is used for agile prey such as /Mysis relicta/ and calanoid copepods. The fish approaches from below, stops, forms an S-shape, and darts at the prey while sucking. 3. A "filtering" fish swims with the mouth fully agape for about 0.5 to 2 sec while driving hard with the tail. 4. "Gulping" is intermediate between filtering and particulate feeding. The fish opens and closes the mouth more slowly than a particulate feeder (about 2-3 times per sec), but does not drive hard with the tail. Particulate feeders and darters take one prey per feeding movement, filterers and gulpers take more than one.

The alewife will feed near or on the bottom only after a training period. Its movements appear uncoordinated and it often misses prey.

76-000727 Kaufman, L. FEEDING BEHAVIOR AND FUNCTIONAL COLORATION OF THE ATLANTIC TRUMPETFISH, /AULOSTOMUS MACULATUS/. Copeia 1976 (2): 377-378. May 1976. SFA 21(2).

[Dep. Earth Planetary Sci., Johns Hopkins Univ., Baltimore, MD 21287]

76-000728 Kjelson, M. A.; Johnson, G. N. FURTHER OBSERVATIONS OF THE FEEDING ECOLOGY OF POSTLARVAL PINFISH, /LAGODON RHOMBOIDES/, AND SPOT, /LEIOSTOMUS XANTHURUS/. NOAA Fish. Bull. 74 (2): 423-432. Apr. 1976. SFA 21(2).

[NMFS, Atlantic Estuarine Fish. Cent., Beaufort, NC 28516] The effect of current on feeding, temporal variation in food consumption, and the effect of predator and prey size on food preferences were evaluated for postlarval stages of pinfish, /Lagodon rhomboides/ (15-19 mm total length); and spot, /Leiostomus xanthurus/ (16-22 mm). Field and laboratory observations indicated that pinfish feeding rates decreased as water current velocity increased. Similar behavior was noted in spot from field observations, but spot feeding rates in the laboratory were highest when a slight current was present. Mean gut contents of postlarvae collected at midday over a 2-mo period ranged from 0.4 to 38 copepods/fish. The mean coefficient of variation for the number of copepods per fish in a single midday sample (/n/ = 20 fish) was 20 percent. Maximum daily feeding rates were estimated at 17 and 26 copepods/h for spot and pinfish, respectively. Field and laboratory data confirmed that as postlarval size increases the size of their prey also increases. Refined estimates of postlarval evacuation rates and daily rations also are presented. Daily ration estimates as a percent of the fish's wet body weight were 9 percent for both species. The ration estimates for both species were greater than metabolic needs estimated from oxygen consumption measurements.

76-000729 Kogan, A. V.; Zaytseva, Ye. M. THE FEEDING OF THE COMMON CASPIAN KILKA [/CLUPEONELLA DELICATULA CASPIA/ MORPHA /TSCHARCHALENSIS/] OF KUYBYSHEV RESERVOIR. J. Ichthyol. (Engl. Transl. Vopr. Iktiol.) 14 (3): 413-417. 1974. SFA 21(2).
[Kuybyshev Stn., Inst. Biol. Inland Waters, USSR Acad. Sci., Tol'yatti, USSR] Information is given concerning the diet of the "common Caspian kilka" of Kuybyshev Reservoir. Changes in the composition of the food of the kilka in the course of its growth are established and some information is given on seasonal and local variations in the composition of the food and the nutritional level of the fish.

76-000730 Kogan, A. V. THE ROLE OF PREDATORY CLADOCERA IN THE FEEDING OF THE TYUL'KA /CLUPEONELLA DELICATULA CASPIA/ MORPHA, /TSCHARCHALENSIS/ IN KUYBYSHEV RESERVOIR. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (1): 110-114. 1975. SFA 21(2).
[USSR Acad. Sci., Tolyatti, USSR] The food spectrum of underyearlings and yearlings of the tyul'ka /Clupeonella delicatula/ and its seasonal and local changes were analyzed. The indices of selection of food items of two age groups of fish were calculated. It was established that at the end of the first year large predatory forms of zooplankton, /Leptodora/ and /Bythotrephes/, become the dominant food of the tyul'ka. They eat these small crustaceans in massive quantities. In order to assess the role of the tyul'ka in a body of water it is proposed to investigate the consumption by tyul'ka stock of predatory and non-predatory forms of zooplankton.

76-000731 Kukuradze, A. M. FOOD FEEDING OF PIKE-PERCH (/LUCIOPERCA LUCIOPERCA/) IN THE DANUBE DELTA AND NEIGHBORING WATERS. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (6): 925-933. 1974. SFA 21(2).
[AzCherNIRO, Azov, USSR] Information is given on the feeding of juvenile and adult pike-perch (/Lucioperca lucioperca/). A regular connection is shown to exist between the diet, age and feeding grounds of the pike-perch. The indices of stomach fulness in different seasons are described in relation to the biological state of the pike-perch. A relationship is established between the size of the predator and the prey. A positive evaluation is given of the biclogical role of the pike-perch as a kind of improving agent consuming fishes of little value.

76-000732 Laurence, G. C. A BIOENERGETIC MODEL FOR THE ANALYSIS OF FEEDING AND SURVIVAL POTENTIAL OF WINTER FLOUNDER LARVAE (/PSEUDOPLEURONECTES AMERICANUS/) DURING THE PERIOD FROM HATCHING TO METAMORPHOSIS. Presented at the 39th Annu. Meeting, Am. Soc. Limnol. Oceanogr., Savannah, Ga., June 21-24, 1976. 1976. SFA 21(2).
[NMFS, Northeast Fish. Cent., Narragansett, R.I. 02882] A bioenergetic model was developed which simulated effects of temperature, prey density, and larval size on ability of winter flounder to obtain food energy to provide for experimentally determined growth and metabolism. Larval feeding at constant temperature and as a function of prey concentration was exponential and more sharply asymtotic in younger fish than in those near metamorphosis. Specific growth rates were exponentially related to prey concentrations and ranged from 5.72 to 8.70 percent/day at survival prey concentrations of 3.7 to 21.7 cal/l. Daily required feeding time was directly related to prey availability. Critical plankton densities below which larvae did not have enough time during the day to obtain adequate food for growth and metabolism varied with age and ranged from 2.1 to 5.7 cal/l. Simulated physiological energy utilization and required caloric food intake were inversely related to

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prey concentration and varied with larval stage of development. Food requirements expressed as numbers of copepod nauplii consumed per day ranged from 19 for first feeding larvae to 235 for metamorphosed juveniles. Predicted gross growth efficiences were directly related to prey concentration and increased with age from 5 to 33 percent. All indications pointed to a "critical period" of larval survival during the period of exogenous feeding initation and immediately after.

76-000733 Lobel, P. S. PREDATION ON A CLEANERFISH (/LABROIDES/) BY A HAWKFISH (/CIRRHITES/). Copeia 1976 (2): 384-385. May 1976. SFA 21(2).
[Mus. Comp. Zool., Harvard Univ., Cambridge, MA 02138]

76-000734 Nasukhov, O. N. THE FEEDING OF THE YOUNG OF VALUABLE FISHES OF THE ARAKUM WATERS IN THE EARLY DEVELOPMENT STAGES AND THE DEGREE OF SIMILARITY OF THEIR DIETS. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (3): 418-425. 1974. SFA 21(2).
[Dagestan Dep. Caspian Fish. Res. Inst., Makhachkala, USSR] Investigations were made of the qualitative and quantitative composition of the food of juvenile Caspian roach, "kutum," rudd and perch. The degree of food similarity in the different development stages of these fishes was determined. The greatest degree of food similarity (61.5-69.2 percent) was noted in juvenile "kutum" and Caspian roach, which is explicable by their coexistence in the better aerated and open parts of the water.

76-000735 Nikol'skiy, G. V.; Aliyev, D. D. THE ROLE OF FAR EASTERN HERBIVOROUS FISHES IN THE ECOSYSTEMS OF NATURAL WATERS IN WHICH THEY ARE ACCLIMATIZED. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (6): 842-847. 1974. SFA 21(2).
[Dep. Ichthyol., Moscow Univ., Moscow, USSR] An examination is made of the influence of herbivorous fishes on the indigenous fish fauna of the waters of the Karakum canal. The introduction of these fishes has led to a considerable increase in total fish productivity. The catches of indigenous fishes have remained at their former level, and those of the wild carp have increased.

76-000736 Parrish, J. D. A TROPHIC STUDY OF THE COMMUNITY OF DEMERSAL FISHES AND BENTHIC INVERTEBRATES NEAR AN OFFSHORE PUERTO RICAN CORAL REEF. Presented by the 39th Annu. Meeting, Am. Soc. Limnol. Oceanogr., Savannah, Ga., June 21-24, 1976. 1976. SFA 21(2)

[Mass. Coop. Fish. Res. Unit, Univ. Mass., Amherst 01002] A saturation diving habitat was used as a base tc sample the benthic community quantitatively and concurrently collect the associated demersal fish fauna. The unconsolidated substrate was habitat for 11 phyla and at least 242 species of animals larger than 0.35 mm, with a numerical density of about 6900 animals/$m^2$. The community was dominated in numbers by polychaetes, amphipods and ascidians (90 percent of the total) and in biomass by ascidians and Reptantia (75 percent of the total). Other significant components of the biomass were ophiuroids, polychaetes, holothurians and Natantia. Gut contents of 27 demersal fish species were examined. Sedentary groups such as ascidians and pelecypods were represented in the guts in approximately the same proportions as in the benthos. Ophiuroids and tanaidaceans were similarly distributed. Polychaetes and amphipods were strongly avoided (numerical Ivlev electivity indices, E, of -0.8 and -0.5 respectively). Reptantia, isopods, gastropods, Natantia and stomatopods were strongly favored (E values of +0.6, +0.84, +0.92,

76-000736, CONTINUED
+0.93, and greater than +0.93 respectively). Heptantia and Natantia were the most important contributors to biomass in the diet of the fishes, followed closely by stomatopods and ascidians. Ophiuroids were of minor importance and other groups less significance.

76-000737 Repsys, A. J.; Applegate, R. L.; Hales, D. C. FOOD AND FOOD SELECTIVITY OF THE BLACK BULLHEAD, /ICTALURUS MELAS/, IN LAKE POINSETT, SOUTH DAKOTA. J. Fish. Res. Board Can. 33 (4,1): 768-775. Apr. 1976. In English with French summ. SFA 21(2).
[Nalco Environ. Sci., Lincoln, NE 68524] Food habits and food selectivity of the black bullhead (/Ictalurus melas/) in Lake Poinsett, South Dakota, were studied from March to November 1970. The black bullhead preyed upon a wide range of food sources in the limnetic, littoral, and benthic zones and seasonal differences in diet occurred in response to availability of prey species. The total food volume in stomachs of 558 black bullheads (143-304 mm total length) comprised about 32 percent planktonic crustaceans, 25 percent chironomids, 27 percent fish, 9 percent crayfish, 2 percent filamentous algae, and 5 percent miscellaneous organisms. Planktonic crustaceans made up 94.4 percent and chironomids made up 5.6 percent of the volume of food ingested by 230 young-of-the-year black bullheads. Black bullheads were most selective for the largest cladocerans available, /Leptodora kindtii/, /Daphnia pulex/, and /D. galeata mendotae/, and /Chironomus/ spp. pupae. Black bullheads were least selective for /Diaphanosoma leuchtenbergianum/, copepods, and chironomid larvae. The black bullhead in Lake Poinsett was primarily a selective planktivore throughout its life history.

76-000738 Ringler, N. H. THE MECHANISM OF SELECTIVE PREDATION IN DRIFT-FEEDING BROWN TROUT (/SALMO TRUTTA/). Ph.D. dissertation, Univ. Mich. 209p. 1975. From Diss. Abstr. Int. B Sci. Eng. 36(10), 1976. SFA 21(2).
This study investigates the mechanism of selective predation by wild brown trout, /Salmo trutta/, in a laboratory stream, and evaluates the extent to which selective feeding optimizes caloric intake. Consumption of drifting prey by visually isolated fish was recorded for 30 minutes each day during 7-day experiments. Prey selection by brown trout changes progressively over relatively short (5-minute) intervals, as well as from day to day. Diet changes were accomplished by reduced consumption of brine shrimp and increased consumption of the alternate prey species. Trout moved vertically and horizontally into areas of high prey density, but the selected diet was not explicable solely on the basis of this movement. Size-selective predation was a dominant characteristic of the response. This appeared to involve development of an active preference for large prey, rather than a process of visual filtering of the smaller prey items. Selectivity was greatest at high total prey densities, evidently because of increased opportunities for learning and shortened periods during which extinction (forgetting) could occur. It is suggested that high prey density could also act as a general feeding stimulus. Some evidence suggested that high relative abundance of prey could result in selection of a prey species; this effect was evidently masked by that of size during most of the experimental period. Selective predation ultimately increased more than threefold the caloric content of the diet relative to a random diet. An explanatory model of the mechanism of selective predation is presented that synthesized the results of the present study and those of other investigators. The model suggested that deviations from the optimum (caloric) diet may be explicable in terms of an overall feeding strategy that deals with heterogeneous distribution of the prey, as well as with the behavioral capabilities of the predator. --From abstr.

76-000739 Stickney, R. R. FOOD HABITS OF GEORGIA ESTUARINE FISHES II. /SYMPHURUS PLAGIUSA/ (/PLEURONECTIFORMES: CYNOGLOSSIDAE/). Trans. Am. Fish. Soc. 105 (2): 202-207. Mar. 1976. SFA 21(2).
[Wildl. Fish. Sci., Texas A & M Univ., College Station 77843] Examination of the digestive tracts of 588 blackcheek tonguefish, /Symphurus plagiusa/, during 1973 and 1974 indicated a primarily benthic feeding habit. Mollusks and various crustaceans were the most common identifiable constituents of the diet during all times of the year in fish of all sizes above postlarvae in both rivers and sounds in Georgia estuaries. Sand grains were present in about half of the fish.

76-000740 Timokhina, A. F. FEEDING AND DAILY FOOD CONSUMPTION OF THE BLUE WHITING [/MICROMESISTIUS POUTASSOU/] IN THE NORWEGIAN SEA. J. Ichthyol. (Engl. Transl. Vopr. Ikhiol.) 14(5): 760-765. 1974. SFA 21(2).
[PINRO, Murmansk, USSR] Euphausiacea and Copepoda (mainly /Thysanoessa inermis/, /Th. longicaudata/, /Calanus finmarchicus/ and /C. hyperboreus/) are of basic significance in the feeding of the blue whiting. The daily food consumption calculated in four ways was 1.6-3 percent of the body weight of the fish. It is suggested on the basis of data for mean indices of fullness of fish stomachs in different months that 1 ton of blue whiting consumes 4-7 tons of food a year. -- From concl.

76-000741 Todd, E. S. TERRESTRIAL GRAZING BY THE EASTERN TROPICAL PACIFIC GOBY /GOBIONELLUS SAGITTULA/. Copeia 1976 (2): 374-377. May 1976. SFA 21(2).
[Inst. Natl. Pesca, Le Tamendi 102 y la Ria, Casilla 5918, Guayaquil, Ecuador]

76-000742 Troshicheva, N. V. THE ROLE OF THE PROSENCEPHALON AND VISUAL RECEPTION IN THE FOOD REFLEXES OF TWO SPECIES OF SCULPINS [COTTIDAE] IN THE BARENTS SEA. J. Ichthyol. (Engl. Transl. Vopr. Ikhitol.) 14 (5): 784-787. 1974. SFA 21(2).
[MMBI, Murmansk, USSR] An account is given of the results of an experimental study of the feeding behavior of 2 sculpin species from the Barents Sea following surgical disconnection of the prosencephalon and visual reception.

76-000743 Tugarina, P. Ya.; Yel'tsova, V. N. THE FEEDING OF THE EASTERN CARP (/CYPRINUS CARPIO HAEMATOPTERUS/) AND ITS FOOD RELATIONSHIPS WITH THE INDIGENOUS FISHES IN LAKE GUSINOYE (BAIKAL BASIN). J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (4): 571-582. 1974. SFA 21(2).
[Biol. Geogr. Res. Inst., Irkutsk Univ., Irkutsk, USSR] The eastern carp (/Cyprinus carpio haematopterus/) is the main consumer of the silt benthos in Lake Gusinoye. The main food components of the carp at an age of 2-9 years are chironomid larvae, mollusks and macrophytes, which predominate in the diet in the spring and autumn. In the summer the carp feeds intensively on water smartweed seeds. Differences in relation to age are weakly expressed in the feeding of 2 to 9 year old fish. Feeding relationships between the carp and the indigenous fishes of Lake Gusinoye are not highly competitive.

76-000744 Vinyard, G. L.; O'Brien, W. J. MODEL PREDICTING FEEDING RATE AND DIET COMPOSITION OF BLUEGILL SUNFISH FEEDING ON ZOOPLANKTON PREY. Presented at the 39th Annu. Meeting, Am. Soc. Limnol. Oceanogr., Savannah, Ga., June 21-24, 1976. 1976. SFA 21(2).
[Univ. Kans., Lawrence 66044] A real-time model of bluegill sunfish (/Lepomis macrochirus/) size selective predation on zooplankton has been developed. The model is based upon the hypothesis that sunfish choose the apparently largest prey available rather than the absolutely largest. A series of binary choice experiments show this to be true. The model generates probablities of a given size prey appearing largest based on prey density and absolute size. the prey are "eaten" according to a stochastic process based on these probabilities. The model also generates the distance a fish would travel to take a given prey under specific circumstances. Knowing the search, pursuit, and handling time the model predicts the diet composition and time taken to acquire such a diet composition. There is excellent concordance between the predictions of the model and published data as well as our own experimental data. Application of the model to field situations, particularly the effect of light intensity and vertical distribution of zooplankton prey is discussed.

76-000745 Wallace, D. C. FEEDING BEHAVIOR AND DEVELOPMENTAL, SEASONAL AND DIEL CHANGES IN THE FOOD OF THE SILVERJAW MINNOW, /ERICYMBA BUCCATA/ COPE. Am. Midl. Nat. 95 (2): 361-376. Apr. 1976. SFA 21(2).
[Dep. Biol., East. Mich. Univ., Ypsilanti 48197] A study of the feeding behavior and of the developmental, seasonal and diel changes of the food and feeding of the silverjaw minnow, /Ericymba buccata/ Cope, in Vigo County, Indiana, involved the analysis of the stomach contents of more than 1400 fish and some 27 hr of field and laboratory observation. This species is a bottom-feeder relying mainly on taste and tactile senses. Its feeding behavior involves random "searching," frequent mouthing of the bottom substrate, "jabbing" and "digging." The intensity and frequency of these activities are influenced by the presence of food and the activity of other members of the school. It feeds throughout the day. The nocturnal food consists mainly of chironomid larvae and the diurnal food, mainly entomostracans. Diptera larvae are the most important spring and summer food, while entomostracans are the most important food in autumn and winter. Smaller fish use a greater volume of entomostracans, a lesser variety of food, and feed more frequently and intensely, while larger fish use a greater volume of Diptera larvae, a wider variety of food, and feed less frequently and intensely. The ecological significance of these findings is discussed.

76-000746 Woodrum, J. E. FOOD PREFERENCE OF LARGEMOUTH BASS (/MICROPTERUS SALMOIDES/ LACEPEDE). Proc. W. Va. Acad. Sci. 48 (1): 29. 1976. Abstract only. SFA 21(2).
[W. Va. Dep. Nat. Resour., P.O. Box 67, Elkins 26241] The food preference of largemouth bass (/Micropterus salmoides/) from Moncove Lake was tested under controlled conditions using Ivlev's Electivity Index (E) and various fish species and crayfish. The general order of preference was as follows: brook silversides (/Labidesthes sicculus/); green sunfish (/Lepomis cyanellus); Bluntnose minnow (/Pimephales notatus/); channel catfish (/Ictalurus punctatus/); bluegill (/Lepomis macrochirus/); and crayfish (/Orconectes obscurus/).

AGE AND GROWTH

76-000747 Gregory, P. A.; Jow, T. THE VALIDITY OF OTOLITHS AS INDICATORS OF AGE OF PETRALE SOLE FROM CALIFORNIA. Calif. Fish Game 62 (2): 132-140. Apr. 1976. SFA 21(2).

[Calif. Dep. Fish Game, Oper. Res. Branch, Sacramento 95814] Otoliths from junenile petrale sole, /Eopsetta jordani/ (Lockington), caught in research vessel trawls from San Francisco and Crescent City Areas of California were used with otoliths frcm petrale sole less than 33 cm (13 inches) from commercial catches off San Francisco to determine their validity as age indicators. Validity of petrale sole otoliths for use in age studies is supported by seasonal formation of the different marginal zones, modes in length frequencies of immature fish that correspond to age groups, and correspondence of calculated and actual sizes of age groups. The formation cf the first annulus is completed in spring over a year after spawning when calculated and observed average lengths are 10.3 cm (4.1 inches) and 11.1 cm (4.4 inches) respectively. Aging criteria are presented to assure proper year class assignment.

76-000748 Huh, H. T.; Calbert, H. E.; Stuiber, D. A. EFFECTS OF TEMPERATURE AND LIGHT ON GROWTH OF YELLOW PERCH AND WALLEYE USING FORMULATED FEED. Trans. Am. Fish. Soc. 105 (2): 254-258. Mar. 1976. SFA 21(2).

[Mar. Stud. Cent., Coll. Agric. Life Sci., Univ Wis., Madison 53706] Growth of age group 0 yellow perch (/Perca flavescens/) and walleye (/Stizostedion vitreum vitreum/) was studied when temperature and light conditions (photoperiod) were varied. Fish, fed formulated dry pellets, were kept for 14 weeks at 16 and 22 C in combination with 8- and 16-hour photoperiods.

Growth ranged from 151 to 539 percent in the walleye and from 79 to 343 percent in the perch during the 14-week period. Best growth for both species was found at 22 C with a 16-hour photoperiod. The temperature of 22 C ± 1 is similar to the optimal temperature for growth of both fish in natural water.

Growth of young walleye appeared to be temperature-dependent, whereas that of yellow perch was more photoperiod-dependent. The influence of temperature on the walleye growth was highly significant (P less than 0.01) for all photoperiods used, whereas it was not significant for yellow perch. The effects of photoperiod on growth of walleye were not significant but they were for yellow perch (P less than 0.05).

76-000749 Kanep, S. V. GENERAL FEATURES OF THE GROWTH AND SEXUAL MATURATION OF THE WHITEFISH (/COREGONUS LAVARETUS/) IN THE USSR. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (6): 911-924. 1974. SFA 21(2).

[GosNIORKh, Leningrad, USSR] Consideration is given to the growth characteristics and the age of sexual maturity by the whitefish (/Coregonus lavaretus/) in the USSR. The rate of weight and length increase is greater in southern waters, where maximum size and weight are reduced and sexual maturity is reached earlier. Water temperature is most closely related to the growth rate of whitefish. The formation of dwarf forms is not typical of the whitefish.

76-000750 Krykhtin, M. L. THE GROWTH OF THE "ZHELTOSHEK" /ELOPICHTHYS BAMBUSA/ IN THE AMUR BASIN. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (1): 88-94. 1975. SFA 21(2).
[TINRO, Khabarovsk, USSR] The age and growth of /Elopichthys bambusa/ in the Amur basin was studied. Equations of dependence between age and size-weight indicators are presented. The age, length and weight at which the zheltoshek population attains its greatest biomass are defined.

76-000751 Kunin, M. A. THE SIZE AND AGE CHARACTERISTICS AND FEEDING OF THE EASTERN BREAM [/ABRAMIS BRAMA ORIENTALIS/] OF THE ARAL SEA. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (2): 260-266. 1974. SFA 21(2).
[VNIRO, Moscow, USSR] Data are given on the size and age composition, growth rate and feeding of the bream of the Aral Sea. Bream of the open Bugun' Bay are compared to the bream of the sheltered Kara-Chalan Bay. These data are compared with published data of the 40's and 50's.

76-000752 Nesterov, A. A. AGE AND GROWTH OF THE NORTH ATLANTIC SAURY [/SCOMBERESOX SAURUS/]. J. Ichthyol. (Engl. Transl. Vopr. Iktiol.) 14 (3): 398-403. 1974. SFA 21(2).
[AtlantNIRO, Kaliningrad, USSR] A method is given for determination of the age of the Atlantic saury [/Scomberesox saurus/]. Consideration is given to the causes of the formation of marks on the scales. The growth rate of the fish is determined from back calculation data.

76-000753 Reshetnikov, Yu. S.; Yermokhin, V. Ya. FAT CONTENT IN WHITEFISHES IN THE SPRING PERIOD. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (1): 155-159. 1975. SFA 21(2).
[USSR Acad. Sci. (IEMEZh), Moscow, USSR]

76-000754 Sakagawa, G. T.; Kimura, M. GROWTH OF LABORATORY-REARED NORTHERN ANCHOVY, /ENGRAULIS MORDAX/, FROM SOUTHERN CALIFORNIA. NOAA Fish. Bull. 74 (2): 271-279. Apr. 1976. SFA 21(2).
[NMFS, Southwest Fish. Cent., La Jolla, CA 92038] The northern anchovy, /Engraulis mordax/, was experimentally reared in the laboratory at the Southwest Fisheries Center, La Jolla, Calif. Data from three experiments were used to empirically fit a two-phase Gompertz growth model. The model describes growth from hatching to about 20 mo of age. It was estimated that the average length of laboratory-reared anchovies is 102 mm at 1 yr and 119 mm at 2 yr old. Growth of laboratory-reared anchovies was comparable to that of anchovies in the wild.

76-000755 Shcherbich, L. V. METHOD OF DETERMINING AGE AND ONSET OF SEXUAL MATURITY IN THE MARBLED ANTARCTIC COD /NOTOTHENIA ROSSI MARMORATE/. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (1): 82-88. 1975. SFA 21(2).
[AtlantNIRO, Kaliningrad, USSR] When determining the age of the marbled Antarctic cod the annual boundary line, allowing for seasonal fluctuation in the Southern Hemisphere, should be taken as 1 July. The age of fish with 20-25 sclerites up to the first well expressed annulus, should be determined according to the number of visible annuli. The age of fish with 45-68 sclerites up to the first well expressed (distinct) annulus, should be calculated by adding one year to the number of visible annuli. The age of the onset of sexual maturity corresponds to the emergence on the scales of the first of

76-000755 CONTINUED
the sharply convergent annual growth zones. --From concl.

76-000756 Spanovskaya, V. D.; Grigorash, V. A. LENGTH-WEIGHT RELATIONSHIP OF SOME SPECIES OF THE GENUS /CYCLOTHONE/ (/PISCES, GONOSTOMATIDAE). J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (1): 146-150. 1975. SFA 21(2).
[Dep. Ichthyol., Moscow Univ. Moscow, USSR]

76-000757 Sukhanov, V. V. A MATHEMATICAL MODEL OF THE SEASONAL DYNAMICS OF WEIGHT INCREASE IN JUVENILE SOCKEYE (/ONCORHYNCHUS NERKA/). J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (4): 491-496. 1974. SFA 21(2).
[Inst. Evol. Physiol. Biochem., USSR Acad Sci., Lenningrad, USSR] The model is devoted to an investigation of the effect of environmental temperature and the level of food resources on the weight increase of juvenile sockeye (/Oncorhynchus nerka/). The model describes the S-shaped nature of the growth of the fish within the annual cycle (acceleration of growth in the spring and retardation toward the winter). In connection with environmental temperature conditions it is shown that lethal limits and an optimum state of the population exist. The effect of food conditions on the growth of the young is established.

76-000758 Zolczynski, S. J., Jr.; Davies, W. D. GROWTH CHARACTERISTICS OF THE NORTHERN AND FLORIDA SUBSPECIES OF LARGEMOUTH BASS AND THEIR HYBRID, AND A COMPARISON OF CATCHABILITY BETWEEN THE SUBSPECIES. Trans. Am. Fish. Soc. 105 (2): 240-243. Mar. 1976. SFA 21(2).
[Div. Game Fish, Dep. Conserv. Nat. Resour., Montgomery, AL 36104] Nine 0.04-hectare ponds of the Alabama Agricultural Experiment Station were used to evaluate growth differences among northern largemouth bass, /Micropterus salmoides salmoides/ (Lacepede), Florida largemouth bass, /Micropterus salmoides floridanus/ (Lesueur), and their hybrid. /Salmoides/ grew faster than /floridanus/ or the hybrid during the first summer of life. Since the environments were similar the differences in growth rates were attributed to genetic factors. The first year growth, therefore, is not the factor which contributed to the larger adult size of the Florida largemouth bass. Angling records from four other ponds indicated that /floridanus/ was significantly more difficult to catch than /salmoides/. The difference is probably great enough to significantly affect the catch in heavily fished bodies of water.

## GEOGRAPHICAL DISTRIBUTION, FISH SURVEYS, ETC.

76-000759 Belyanina, T. N. LARVAL FISHES OF THE FAMILY HOLOCENTRIDAE IN FISH PLANKTON FROM THE GULF OF TONKIN. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (2): 248-253. 1974. SFA 21(2).
[Inst. Oceanol., USSR Acad. Sci. (IOAN), Moscow, USSR] The article contains a description and illustraitons of a series of larvae of /Ostichthys japonicus/ (Cuv. et Val.) from the Gulf of Tonkin; a comparison is made with corresponding data on the development and morphology of members of the genera /Holocentrus/ and /Myripristis/. The adaptive significance of rapid development and reduction of the strong spines on the head in the early ontogeny of the Holocentridae is discussed. Diagnostic characters of larvae of genera of the family Holocentridae are presented.

76-000760 Belyanina, T. N.; Lopes, G. R. THE OCCURRENCE OF /BREGMACEROS NECTABANUS/ (PISCES, BREGMACEROTIDAE) IN THE CARIBBEAN SEA. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (3): 447-449. 1974. SFA 21(2).
[Inst. Oceanol., USSR Acad. Sci., Moscow, USSR]

76-000761 Boles, G. L. A RANGE EXTENSION FOR THE LOGPERCH, /PERCINA MACROLEPIDA/, IN CALIFORNIA. Calif. Fish Game 62 (2): 154. Apr. 1976. SFA 21(2).
[221 W. 6th Ave., Chico, CA 95926]

76-000762 Faber, D. J. HYPONEUSTONIC FISH LARVAE IN THE NORTHUMBERLAND STRAIT DURING SUMMER 1962. J. Fish. Res. Board Can. 33 (5): 1167-1174. May 1976. In English with French summ. SFA 21(2).
[Natl. Mus. Nat. Sci., Can. Oceanogr. Identification Cent., Ottawa, ON K1A 0M8, Canada] A neuston net with mesh openings of 1.3 mm was towed in the surface waters of the north basin of the Northumberland Strait at irregular intervals from mid-June to mid-September 1962. Fifteen genera of teleost larvae belonging to 11 families were collected. Of these, the following eight species occurred in regular abundance and were termed "abundant larvae": sand lance, /Ammodytes americanus/; radiated shanny, /Ulvaria subbifurcata/; lumpfish, /Cyclopterus lumpus/; fourbeard rockling, /Enchelyopus cimbrius/; Atlantic mackerel, /Scomber scombrus/; cunner, /Tautogolabrus adspersus/; white hake, /Urophycis tenuis/; and Atlantic herring, /Clupea harengus harengus/. Larvae were collected in variable numbers, with the sampling data suggesting they were aggregated in the water. The total abundance of all larvae was about 50 larvae per two except for a peak in July. The regular appearance of the "abundant larvae" resulted in unique combinations of spawning and hatching times for each species. The larvae of spring-spawners were present in June and were gradually replaced by the larvae of summer-spawners.

76-000763 Fursa, T. I. LARVAE OF /BREGMACEROS MACCLELLANDI/ (PISCES, BREGMACEROTIDAE) FROM THE ARABIAN SEA. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (1): 139-142. 1975. SFA 21(2).
[AzcherNIRO, Kerch, USSR]

76-000764 Gavlena, F. K. THE "BLACK-STRIPED PIPEFISH" [/SYNGNATHUS NIGROLINEATUS/], A NEW ELEMENT IN THE FISH FAUNA OF THE VOLGA RESERVOIRS. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (5): 800-801. 1974. SFA 21(2).
[USSR Acad. Sci., Kuybyshev, USSR]

76-000765 Gubanov, Ye. P. THE CAPTURE OF A GIANT SPECIMEN OF THE MAKO SHARK (/ISURUS GLAUCUS/) IN THE INDIAN OCEAN. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (4): 589-590. 1974. SFA 21(2).
[AzCherNIRO, Kerch, USSR]

76-000766 Hoff, J. G. A FIRST RECORD OF /GOBIONELLUS BOLEOSOMA/ (JORDAN AND GILBERT) FOR NEW ENGLAND. Chesapeake Sci. 17 (1): 65. Mar. 1976. SFA 21(2).
[Southeast. Mass. Univ., North Dartmouth 02747]

76-000767 Huntsman, G. R.; Dixon, R. L.; Grimes, C. E.; Manooch, C. S.; Parker, R. O., Jr. DISTRIBUTION OF REEF FISHES ON THE OUTER CONTINENTAL SHELF OF THE CAROLINAS. Presented at the 39th Annu. Meeting, Am. Soc. Limnol. Oceanogr., Savannah, Ga., June 21-24, 1976. 1976. SFA 21(2).
[NMFS, Atlantic Estuarine Fish. Cent., Beaufort, NC 28516] Two demersal fish faunas, one temperate, one tropical exist side by side on the South Atlantic Shelf. Irregular rocky topography and warm Gulf Stream water provide suitable habitat for tropical, deep-water, reef fishes on the outer edge of the Continental Shelf of North Carolina and South Carolina whereas the inshore fauna is primarily temperate.
Tropical fishes are found year around in depths as shallow as 30 m, but their distribution in any abundance ceases at Cape Hatteras. Experimental fishing and records obtained from a sport fishery from May 1972 through October 1975 indicate that red porgy, /Pagrus pagrus/, vermilion snapper, /Rhomboplites aurorubens/ and several species of groupers, /Epinephelus/ and /Mycteroperca/, are the most abundant fishes in the tropical community. Tilefish, /Caulolatilus/, are common in depths greater than 70 m and white grunt, /Haemulon plumieri/, are abundant over rocky areas from 30 to 45 m.

76-000768 Mina, M. V. SOME OBSERVATIONS ON THE RANGE OF THE BALKHASH PERCH [/PERCA SCHRENKI/] AND ITS INTERRELATIONSHIPS WITH THE COMMON PERCH [/P. FLUVIATILIS/]. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (2): 292-293. 1974. SFA 21(2).
[Dep. Ichthyol., Univ. Moscow, USSR]

76-000769 Moore, R. H.; Garrett, R. A.; Wingate, P. J. OCCURRENCE OF THE RED SHINER, /NOTROPIS LUTRENSIS/, IN NORTH CAROLINA: A PROBABLE AQUARIUM RELEASE. Trans. Am. Fish. Soc. 105 (2): 220-221. Mar. 1976. SFA 21(2).
[Dep. Biol., Coastal Carolina Coll., Univ. S. C., Conway 29526] The red shiner /Notropis lutrensis/, is reported from North Carolina for the first time. This record, the first east of the Appalachian mountains, represents a range extension of approximately 850 km. This population probably originated from the escape or release of aquarium or bait fish.

76-000770 Nizovtsev, G. P. A GREENLAND HALIBUT [/REINHARDTIUS HIPPOGLOSSOIDES/] TAGGED IN EASTERN ICELANDIC WATERS AND CAUGHT IN THE BARENTS SEA. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (2): 286. 1974. SFA 21(2).
[PINRO, Murmansk, USSR]

76-000771 Page, L. M.; Burr, B. M.; Smith, P. W. THE SPOTTAIL DARTER, /ETHEOSTOMA SQUAMICEPS/ (OSTEICHTHYES, PERCIDAE), IN INDIANA. Am. Midl. Nat. 95 (2): 478-479. Apr. 1976. SFA 21(2).
[Ill. Nat. Hist. Surv., Urbana 61801] The spottail darter, /Etheostoma squamiceps/, was reported from two localities in Posey Co., Indiana, by Jordan in 1890. All subsequent authors on Indiana fishes failed to record any new observations on the species, but it is still present, though rare, in at least two localities in Posey County. The spottail darter should be added to the State's rare and

76-000771 CONTINUED
endangered species list.

76-000772 Pashkova, T. Ye. THE OCCURRENCE OF SPAWNING CAPELIN [/MALLOTUS VILLOSUS VILLOSUS/] IN INDIGA BAY IN THE BARENTS SEA. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (5): 802-803. 1974. SFA 21(2).
[PINRO, Murmansk, USSR]

76-000773 Pinchuk, V. I. NEW DATA ON /RHINOGOBIUS PFLAUMI/ AND /RHINOGOBIUS SIMILIS SIMILIS/ IN THE MARITIME TERRITORY. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (3): 373-377. 1974. SFA 21(2).
[Inst. Mar. Biol., Far East. Sci. Cent., USSR Acad. Sci., Vladivostok, USSR] /Rhinogobius pflaumi/, regarded as a rare species in our fauna, has been found to be extremely common in some parts of Amur Bay. /Rhinogobius similis similis/, nor previously found in the Sedanka River (before the creation of the reservoir), has been found to be very numerous in the Malaya Sedanka River near the reservoir. A description of the coloration of both species and their morphometric characters are presented.

76-000774 Powles, H. W. ABUNDANCE, SEASONALITY, DISTRIBUTION, AND ASPECTS OF THE ECOLOGY OF SOME LARVAL FISHES OFF BARBADOS. Ph.D. dissertation, McGill Univ. 1975. From Diss. Abstr. Int. B Sci. Eng. 36(10), 1976. SFA 21(2).
Samples of larval fishes have been collected in the ocean off Barbados, over a period of 10 months, and immediately over inshore spawning areas, over a period of 19 months. Overall composition, by families, of the larval fish catch, and seasonal changes in the catch of larvae of selected families are described. Island mass effects on distribution of the larvae of two oceanic fishes (/Cubiceps athenae/, family Nomeidae; /Bregmaceros atlanticus/, family Bregmacerotidae) are described. The relative importance of inshore currents and of currents further offshore in the wake of the island on drift and retention of planktonic larvae of insular fishes is discussed with reference to observations on distribution of these larvae. Larvae of /Equetus/ sp. (family Sciaenidae) and of /Jenkinsia lamprotaenia/ (family Clupeidae) are described and figured; both appear to be at least partly epibenthic, rather than planktonic.

76-000775 Schaeffer, B.; Mangus, M. AN EARLY TRIASSIC FISH ASSEMBLAGE FROM BRITISH COLUMBIA. Bull. Am. Mus. Nat. Hist. 156 (5): 515-564. May 1976. SFA 21(2).
[Dep. Vertebr. Paleontol., Am. Mus. Nat. Hist., Central Park West at 79th St., New York, NY 10024]

76-000776 Shubnikov, D. A. ECOLOGICAL GROUPS IN THE SCOMBRIDAE AND THEIR ORIGIN. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (5): 633-648. 1974. SFA 21(2).
[VNIRO, Moscow, USSR] An examination is made of the characteristics of the present distribution and schooling behavior of mackerels. Trophic factors govern the existing distribution of species in the family and the origin of intraspecific ecological groups. A phylogenetic outline is given of the distribution of the family in the main biotopes of the pelagic zone.

76-000777 Snytko, V. A.; Fedorov, V. V. NEW DATA ON THE DISTRIBUTION OF SCORPAENID FISHES OF THE SUBFAMILY SEBASTINAE AND NOTES ON THEIR BIOLOGY. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (6): 811-818. 1974. SFA 21(2).

[TINRO, Vladivostik, USSR] New data are given on the distribution of /Helicolenus hilgendorfi/, /Sebasticus/ sp. n., /Sebastes matsurbarae/, /S. aleutianus/, /S. baramenuke/, /S. flameus/, /S. iracundus/, /S. borealis/, /S. reedi/, /S. itinus/, /S. scytropus/, /S. brevispinis/, /S. ciliatus/, /S. polyspinis/, /S. variegatus/ and /Sebastes/ sp. n. It is possible that some of the species along the American coast are extending their range at the expense of the ecological niche of /S. alutus/, left vacant as a result of overfishing for this fish.

76-000778 Stewart, D. J.; Brandt, S. B.; Magnuson, J. J.; Kitchell, J. F. DISTRIBUTIONAL RESPONSE OF FISH TO A THERMAL FRONT IN THE ATLANTIC OCEAN NEAR CAPE HATTERAS. Presented at the 39th Annu. Meeting, Am. Soc. Limnol. Oceanogr., Savannah, Ga., June 21-24, 1976. 1976. SFA 21(2).

[Univ. Wis., Madison 53706] A thermal front between Gulf Stream and Virginian water masses was located north of Cape Hatteras off Oregon Inlet in June, 1975. Bottom water temperature changed 12C in 5 km at the interface. Distribution of fishes was studied by intensive trawling in selected temperature strata of the thermal gradient and by trawling in sample grids, 1) off Cape Lookout 2) at Cape Hatteras 3) 40 km north of the front, and 4) near Norfork Canyon. The thermal defined a boundary between northern cold water and southern warm water fish faunas of the continental shelf and resembled an ecotone with relatively high fish abundance and diversity. 19 taxa (out of 90), including /Micropogon undulatus/ and /Leiostomus xanthurus/ were found only at the front. Midwater acoustic estimates of fish abundance correlated with trawl catches and showed fish (/Estrumeus teres/ and /Anchoa/) concentrated at the thermal front. Temperature seemed of greater importance than the geological configuration of Cape Hatteras as a moderator of fish distribution.

76-000779 Tucker, J. W., Jr.; Hodson, R. G. EARLY AND MID-METAMORPHIC LARVAE OF THE TARPON, /MEGALOPS ATLANTICA/, FROM THE CAPE FEAR RIVER ESTUARY, NORTH CAROLINA, 1973-74. Chesapeake Sci. 17 (2): 123-125. June 1976. SFA 21(2).

[Dep. Zool., N.C. State Univ., P.O. Box 5577, Raleigh 27607] Sampling of larval fishes in the Cape Fear River Estuary and at the Brunswick Steam Electric Plant intake and discharge structures, near Southport, North Carolina, yielded 24 metamorphic tarpon, /Megalops atlantica/, larvae during 1973-74. These larvae were probably spawned somewhere off or to the south of Cape Fear from April or May to September. All larvae taken in the river were collected near the bottom at or just after low tide, while most of those caught in tidal creeks were near the surface, but also were caught near the time of low tide. A possible explanation for this difference is the development of air-breathing in the shrinking larvae. Larvae appear to be more active at night and may thereby avoid high daytime predation.

76-000780 Zhakov, L. A. THE COMPOSITION SUCCESSIONS OF LAKE ICHTHYOCOENOSES IN RELATION TO THE SPECIFIC FEATURES OF FAUNISTIC COMPLEXES OF FISHES. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (2): 208-218. 1974. SFA 21(2).

[Vologda Pedogog. Inst., USSR] An examination has been made of the ichthyocoenoses of 248 lakes in Vologda Province, 28 lakes in Yaroslavl Province and 105 lakes in Sweden. It has been established by constructing graphs of the fish fauna of these regions that a dominant and a subdominant part may be distinguished in each ichthyocoenosis. These parts are distinguished by a different degree of the co-adaptation of the fishes to each other. The transformation of some ichthyocoenoses into others is traced. It is noted that successions are specific in relation to the faunistic complexes of fishes forming the ichthyocoenoses.

ABUNDANCE, FACTORS OF; SURVIVAL AND MORTALITY

76-000781 Forney, J. L. YEAR-CLASS FORMATION IN THE WALLEYE (/STIZOSTEDION VITREUM VITREUM/) POPULATION OF ONEIDA LAKE, NEW YORK, 1966-73. J. Fish. Res. Board Can. 33 (4,1): 783-792. Apr. 1976. In English with French summ. SFA 21(2).

[Dep. Nat. Resour., Cornell Univ., Ithaca, NY 14853] Abundance of eight successive year-classes of walleyes (/Stizostedion vitreum vitreum/) was measured at intervals from hatching into the second year. Each year-class arose from an initial stock of 12-18 billion eggs. Population of pelagic larvae was augmented in some years by the release of hatchery-reared larvae but the effect on year-class size was obscured by mortality after young became demersal. Decrease in number of fingerlings was attributed to predation by older walleyes. Intensity of predation was influenced by abundance of alternate prey and duration of cannibalism by growth of young walleyes. Five year-classes that were monitored through age 4 contributed 12,000-478,000 walleyes to the adult stock.

76-000782 Hunter, J. R. (ed.) REPORT OF A COLLOQUIUM ON LARVAL FISH MORTALITY STUDIES AND THEIR RELATION TO FISHERY RESEARCH, JANUARY 1975. NOAA Tech. Rep. NMFS Circ. 395. iii + 5p. May 1976. SFA 21(2)

[NMFS, Southeast Fish. Cent., P.O. Box 271, La Jolla, CA 92038] One of the critical problems in fishery research today is the inability to determine how the abundance of adult fishes affect the strength of incoming year classes. The report summarized the discussions of experts on how studies of larval fish mortality may assist in solving this problem. Included in this report are discussions of the principle causes of larval mortality and their possible relation to stock size. Guidelines and recommendations are made regarding future research on the mortality of larval fish.

76-000783 Kuznetsov, V. A. THE ADAPTIVE SIGNIFICANCE OF CHANGES IN THE QUALITY OF THE EGGS AND OF FECUNDITY IN THE REPRODUCTION OF A POPULATION OF SICHEL (/PELECUS CULTRATUS/). J. Ichtyhol. (Engl. Transl. Vopr. Ikhtiol.) 14 (4): 539-544. 1974. SFA 21(2).

[Dep. Vertebr. Zool., Kazan Univ., USSR] Consideration is given to the dependence of fecundity, the size and weight of the eggs and the amount of fat in the eggs and muscles on the length, weight, age and growth of female sichel (/Pelecus cultratus/). A correlation is established between fecundity and the fat content of the eggs and muscles. The adaptive significance of the established correlations is

76-000783 CONTINUED
discussed.

IDENTIFICATION, KEYS, CLASSIFICATION

76-000784 Abdil'dayev, M. A.; Dubitskiy, A. M. THE DISCOVERY OF /APLOCHEILUS/ SP., A SPECIES NEW TO THE SOVIET FAUNA, IN THE ILI RIVER BASIN. J. Ichthyol. (Engl. Transl. Vopr. Ikhticl.) 14 (2): 287-289. 1974. SFA 21(2).
[Inst. Zool., Kazakh Acad. Sci., Alma-Ata, USSR]

76-000785 Briggs, J. C. A NEW GENUS AND SPECIES OF CLINGFISH FROM THE WESTERN PACIFIC. Copeia 1976 (2): 339-341. May 1976. SFA 21(2).
[Dep. Biol., Univ. South Fla., Tampa 33620] A small, new species of clingfish from the Bismark Archipelago and the Fiji Islands is described. It belongs to a new genus that is apparently specialized for a commensal relationship with certain shallow reef crinoids. Information is presented about the crinoid in the Fiji area and also a useful method for collecting live specimens of the clingfish. The new genus belongs to the Deadenichthyinae. Included is a key whereby the three genera in the subfamily may be identified using external characters. [Discotrema crinophila].

76-000786 Castle, P. H. J. THE EEL /AOTEA ACUS/ A SYNONYM OF /MURAENICHTHYS BREVICEPS/. Copeia 1976 (2): 365-366. May 1976. SFA 21(2).
[Dep. Zool., Victoria Univ., Private Bag, Wellington, New Zealand]

76-000787 Chambers, J. R.; Musick, J. A.; Davis, J. METHODS OF DISTINGUISHING LARVAL ALEWIFE FROM LARVAL BLUEBACK HERRING. Chesapeake Sci. 17 (2): 93-100. June 1976. SFA 21(2).
[U.S. Army Corps Eng., Lower Miss. Valley Div., Vicksburg, MS 39180] Larval /Alosa pseudoharengus/ may be distinguished from larval /A. aestivalis/ by differences in the relative termination of the vent. The number of myomeres between the insertion of the dorsal fin and the vent is diagnostic. The mean number is 8.0 in /A. pseudoharengus/ and 11.8 /A. aestivalis/. Also of use in distinguishing between larvae of the two species are the number of preanal myomeres, the regression of the distance from snout to vent on standard length, the regression of the distance from vent to tail on standard length. Methods of distinguishing larval /A. pseudoharengus/ and /A. aestivalis/ from commonly associated species in the Chesapeake Bay region are discussed.

76-000788 Gritsenko, O. F. SYSTEMATICS OF FAR EASTERN RUDD OF THE GENUS /TRIBOLODON/ [-/LEUCISCUS BRANDTI/] (CYPRINIDAE). J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (5): 677-689. 1974. SFA 21(2).
[VNIRO, Moscow, USSR] Three species of Far Eastern rudd are segregated into a separate genus on the basis of differences in the types of breeding colors, in morphological characters and in mode of life.

76-000789 Hoese, D. F. VARIATION, SYNONYMY AND A REDESCRIPTION OF THE GOBIID FISH /ARUMA HISTRIO/ AND A DISCUSSION OF THE RELATED GENUS /OPHIOGOBIUS/. Copeia 1976 (2): 295-305. May 1976. SFA 21(2).
[Dep. Ichthyol., Australian Mus., Sydney, Australia] The eastern Pacific genus /Aruma/ contains a single species, /A. histrio/. The nominal species /Gobiosoma occidentale/ represents the southern morphological form of /A. histrio/ and is regarded as a synonym of that species. The species is restricted to the Gulf of California and shows geographical variation in coloration, fin ray, vertebral, and gill-raker counts. The genus /Aruma/ is related to the Chilean genus /Ophiogobius/. /Ophiogobius jenysni/ is proposed as a replacement name for /Gobius ophiocephalus/ Jenyns (1842).

76-000790 Klyukanov, V. A. THE SYSTEMATIC POSITION OF THE OSMERIDAE IN THE ORDER SALMONIFORMES. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (1): 1-17. 1975. SFA 21(2).
[Inst. Zool., USSR Acad. Sci., Leningrad, USSR] Comparative morphological studies have substantiated the extent of the suborder Salmonoidei, consisting of three families, the Osmeridae, Salmonidae and Plecoglossidae, the Osmeridae being the most generalized and closer than the others to the original ancestral form. A certain similarity in the skeletal structure of the families Osmeridae and Gonostomatidae (suborder Stomiatoidei) is explained by their position at the base of the suborders. Among the salmoniform fishes, the family Salmonidae is relatively primitive. The family Plecoglossidae, belongs to a specialized branch of salmoniform fishes.

76-000791 Palmer, G.; Oelschlager, H. A. USE OF THE NAME /LAMPRIS GUTTATUS/ (BRUNNICH, 1788) IN PREFERENCE TO /LAMPRIS REGIUS/ (BONNATERRE, 1788) FOR THE OPAH. Copeia 1976 (2): 366-367. May 1976. SFA 21(2).
[British Mus. Nat. Hist., London, England]

76-000792 Permitin, Yu. Ye.; Sazonov, Yu. I. THE SYSTEMATICS OF /NOTOTHENIA SQUAMIFRONS/ GUNTHER AND RELATED SPECIES. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (4): 503-514. 1974. SFA 21(2).
[VNIRO, USSR Acad. Sci., Moscow, USSR] A comparative morphological description is given of three species of the genus /Notothenia/: /N. squamifrons/, /N. macrophthalma/ and /N. kempi/. Redescriptions are given of these species and /N. squamifrons/ is noted to be identical to /N. brevipectoralis/; a new subspecies, /N. squamifrons atlantica/ subsp. n., is described. An identification key to the species and subspecies of the group is given and aspects of their geographic range are discussed.

76-000793 Pinchuk, V. I. /ALECTRIDIUM AURANTIACUM/ FROM THE COMMANDER ISLANDS AND /PSEUDOALECTRIAS TARASOV/ FROM THE KURIL ISLANDS, AND AN UNUSUAL SPECIMEN OF /STICHAEOPSIS EPALLAX/ (PISCES, STICHAEIDAE). J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (6): 818-824. 1974. SFA 21(2).
[Inst. Mar. Biol., Far East. Sci. Cent., USSR Acad. Sci., Vladivostock, USSR] Confirmation is provided for the communication of Peden (1967) concerning the validity of /Alectridium auranticum/. The discovery of /Pseudoalectrias tarasovi/ on the Kuril' Islands is also reported, and a description is given of a series of well preserved specimens, including new information on the coloration of this species during life and on its size. A description is given of a specimen of /Stichaeopsis epallax/, in which the structure of the seismosensory system of the trunk is of an intermediate nature between that of this

76-000793 CONTINUED
species and of /S. nevelskoi/.

76-000794 Shaposhnikova, G. Kh. THE "PYZHYAN" WHITEFISH (/COREGONUS LAVARETUS PIDSCHIAN/) OF THE SOVIET UNION. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (5): 649-666. 1974. SFA 21(2).
[Zool. Inst., USSR Acad. Sci., Leningrad, USSR] The "pyzhyan" is one of the subspecies of the widely distributed species /Coregonus lavaretus/. It forms semi-diadromous, river, lake-river and lake populations that differ in morphological characteristics. Only a few of the 24 nations and subnations of the "pyzhyan" that have been described merit taxonomic recognition, in accordance with the existing rules, in which the subspecies is regarded as the lowest taxon. /C. lavaretus fluviatilis/ and /C. l. glacialis/, previously regarded as nations are treated as subspecies. /C. l. pravdinellus/, /C. l. baunti/, /C. l. oronensis/ and /C. l. baicalensis/ are known in lakes in the southern parts of the range of /C. lavaretus/ in Siberia.

76-000795 Smith-Vaniz, W. F. A REVISION OF THE SABER-TOOTHED BLENNIES, TRIBE NEMOPHINI (PISCES:BLENNIDAE). Ph.D. dissertation, Univ. Miami 444p. 1975. From Diss. Abstr. Int. B Sci. Eng. 36(12), 1976. SFA 21(2).
The blenniid tribe Nemophini is revised based on the examination of slightly more than 1,500 collections. Two new subgenera, 13 new species and one new subspecies are described. A total of five genera (including one genus with two subgenera and two genera each with three subgenera) and 41 species (including three species each with two subspecies) are recognized. The genera recognized are--/Petroscirtes/, /Aspindontus/, /Xiphasia/, /Meiacanthus/ and /Plagiotremus/. Nine nominal genus-group names and 28 nominal species names aer relegated to synonymy. A neotype is designated for /Petrcscirtes variabilis/ Cantor. An identification key is provided for all taxa except subspecies. Sexual dimorphism, geographic variation and distribution, biology, nomenclature and relationships are discussed. All taxa are illustrated and their distributions are plotted on maps. More than a third of the species of Nemophini appear to be involved in mimetic relationships. Possible reasons for such interactions are discussed and several leads for additional study are suggested. The Nemophini is the most specialized tribe within the Blenniidae, and the structural and behavioral diversity of the tribe is remarkable for such a small group of closely related fishes. /Meiacanthus/ is the only fish genus known to possess toxic buccal glands. The three subgenera of /Meiacanthus/ can be recognized solely on the basis of gland morphology. /Plagiotremus/ possesses unique trophic specializations associated with an obligatory, predacious scale-eating habit.

## PARASITES AND DISEASES-GENERAL

76-000796 Amend, D. F.; Fender, D. C. UPTAKE OF BOVINE SERUM ALBUMIN BY RAINBOW TROUT FROM HYPEROSMOTIC SOLUTIONS: A MODEL FOR VACCINATING FISH. Science 192 (4241): 793-794. 21 May 1976. SFA 21(2).
[U.S. FWS, Western Fish Disease Lab., Seattle, WA 98115] Immersion of juvenile rainbow trout (/Salmo gairdneri/) in a solution containing either urea or sodium chloride at 1650 milliosmoles and 2 percent of bovine serum albumin (BSA) resulted in an uptake of BSA into the blood of the fish after a 3-minute exposure. Similar blood levels of BSA were also obtained by placing the fish in 1650 milliosmoles of sodium chloride for about 2 minutes, and then immersing them in 2 percent BSA

76-000796 CONTINUED
solution for 3 minutes. Uptake of BSA into the fish appeared to be primarily through the lateral line system and secondarily through the gills.

76-000797 Anonymous O.I.E. MEETING OF EXPERTS FOR THE STUDY OF CRITERIA THAT MAY BE FOLLOWED IN ESTABLISHING SPECIFIC PATHOGEN FREE (S.P.F.) AND MINIMUM DISEASE (M.D.) FISH FARMS. Riv. It. Piscic. Ittiop. 11 (2): 50-53. Apr.-May-June 1976. SFA 21(2).

76-000798 Astakhova, T. V. THE PARASITE FAUNA OF JUNENILE STURGEON OF THE VOLGA-CASPIAN REGION. J. Ichthyol. (Eng. Transl. Vopr. Ikhtiol.) 14 (5): 788-792. 1974. SFA 21(2).
A study has been made of the parasite fauna of juvenile Russian sturgeon (/Acipenser guldenstadti/), beluga (/Huso huso/) and sevryuga (/Acipenser stellatus/) in hatcheries, in the river and in the sea. Information is given concerning the effect of pond, tank and combined methods of rearing in hatcheries on the parasite fauna of juvenile sturgeon.

BACTERIAL DISEASES

76-000799 Antipa, R. FIELD TESTING OF INJECTED /VIBRIO ANGUILLARUM/ BACTERINS IN PEN-REARED PACIFIC SALMON. J. Fish. Res. Board Can. 33 (6): 1291-1296. June 1976. In English with French summ. SFA 21(2).
[Fish. Res. Inst., Coll. Fish., Univ. Wash., Seattle 98195] Intraperitoneal injection of three types of /Vibrio anguillarum/ bacterin (heat-killed, formalin-killed, and a combination of heat and formalin-killed) was tested in chinook (/Oncorhynchus tshawytscha/) and coho salmon (/O. kisutch/) to assess the feasibility of preventing vibriosis by immunization in commercial aquaculture. A single injection of /V. anguillarum/ bacterin gave substantial protection to chinook salmon for 6 mo postinoculation (32 percent mean mortality in all injected groups) in comparison to the control group (85 percent mortality). Chinook salmon showed the highest survival when treated with the heat-killed /V. anguillarum/ bacterin. All groups of coho salmon had less than 7.0 percent mortality, and immunization was not beneficial to survival. Serum antibody titer of /V. anguillarum/ agglutinins was increased by intraperitoneal injection. /Vibrio anguillarum/ was the pathogen most frequently isolated from moribund chinook salmon; /Aermonas salmonicida/ was the predominant organism isolated from moribund coho salmon.

76-000800 Braaten, B. A.; Hodgins, H. O. PROTECTION OF STEELHEAD TROUT (/SALMO GAIRDNERI/) AGAINST VIBRIOSIS WITH A LIVING LOW-VIRULENCE STRAIN OF /VIBRIO ANGUILLARUM/. J. Fish. Res. Board Can. 33 (4,1): 845-847. Apr. 1976. In English with French summ. SFA 21(2).
[NMFS, Northeast Fish. Cent., Seattle, WA 98112] Exposure to a living low-virulence strain of /Vibrio anguillarum/ was found to protect steelhead trout (/Salmo gairdneri/) against a subsequent challenge of highly virulent /V. anguillarum/. The fish were effectively protected by means of a single intraperitoneal injection or by multiple oral vaccinations.

76-000801 Fryer, J. L.; Pilcher, K. S.; Sanders, J. E.; Rohovec, J. S.; Zinn, J. L.; Groberg, W. J.; McCoy, R. H. TEMPERATURE, INFECTIOUS DISEASES, AND THE IMMUNE RESPONSE IN SALMONID FISH. U.S. Environ. Prot. Agency Ecol. Res. Ser. EPA-600/3-76-21. Apr. 1976. SFA 21(2).

[Microbiol. Dep., Oreg. State Univ., Corvallis 97331] Investigations of the effect of temperature on infections of salmonid fish were conducted. /Aeromonas salmonicida/ infection was studied in chinook salmon and steelhead trout; /Aeromonas liquefaciens/ infection in chinook salmon and coho salmon. In all cases mortality rates were high at 64 to 69 F; usually moderate at 54 to 59 F; and low or zero at 39 to 49 F. Progress of the infections was accelerated at higher temperatures, and retarded at lower temperature levels.

Bacterial kidney disease was studied in coho salmon and steelhead trout. The temperature range of 44 to 54 F was optimal for the development of fatal infection, as indicated by mortality rates of 78 to 100 percent. Higher temperatures had a suppressing effect, which was marked at 69 F.

Temperatures of 59 to 69 F were optimal for the formation of agglutinating antibody when juvenile coho salmon were injected with a killed suspension of /A. salmonicida/. At lower temperatures less antibody was formed, and no significant amount was produced at 39 F 60 days after injection of antigen.

Oral immunization of juvenile coho salmon with a vaccine consisting of formalin killed /Vibrio anguillarum/ cells incorporated in their diet protecting them against fatal infection when the fish were held at temperatures from 39 to 69 F during immunization.

76-000802 Harrell, L. W.; Novotny, A. J.; Schiewe, M. H.; Hodgins, H. O. ISOLATION AND DESCRIPTION OF TWO VIBRIOS PATHOGENIC TO PACIFIC SALMON IN PUGET SOUND, WASHINGTON. NOAA Fish. Bull. 74 (2): 447-449. Apr. 1976. SFA 21(2).

[NMFS, Northwest Fish. Cent., 2725 Montlake Blvd. East, Seattle, WA 98112] /Vibrio/ sp. 1669 was typical of the marine vibrio group: it was characterized as a gram negative, motile, curved, asporogenous rod that was oxidase positive, an anaerogenic fermenter, and sensitive to the vibriostatic compound 0/129. A slower rate of grouth of /Vibrio/ sp. 1669, in comparison to /V. anguillarum/ 775, was observed on TSA, as well as variations in certain culture reactions.

Coho salmon anti-/V. anguillarum/ 775 serum with an agglutinin titer of 512 against the homologous bacterium had a titer of 8 against /Vibrio/ sp. 1669. Immunodiffusion also revealed differences between the two vibrios.

After all detectable agglutinin activity against /V. anguillarum/ 775 in rabbit anti-/Vibrio/ sp. 1669 serum was removed by absorption, a titer of 16 against 1669 remained indicating that /Vibrio/ sp. 1669 also contains antigenic determinants not present on /V. anguillarum/ 775.--From results and discussion

76-000803 Sanders, J. E.; Holt, R. A.; Fryer, J. L. SEROLOGICAL COMPARISON OF /FLEXIBACTER COLUMNARIS/ ISOLATES USING RABBIT AND RAINBOW TROUT (/SALMO GAIRDNERI/) ANTISERA. J. Fish. Res. Board Can. 33 (6): 1386-1388. June 1976. In English with French summ. SFA 21(2).

[Dep. Microbiol., Oreg. State Univ., Corvallis 97331] Bacterial agglutination tests with antisera from rabbit and rainbow trout (/Salmo gairdneri/) revealed a common antigen(s) in each of the three isolates. Assays with adsorbed antisera from both species indicated that the three isolates belonged to two serological groups with each group having its own unique antigen(s). These similarities with rainbow trout and rabbit antisera indicate that the serotypes of /Flexibacter columnaris/ as defined by rabbit antisera are like those recognized by salmonids. This suggests that these distantly related

76-000803 CONTINUED
vertebrates both responded to the same surface antigens of the /F. columnaris/ isolates.

76-000804 Shotts, E. B., Jr.; Kleckner, A. L.; Gratzek, J. B.; Blue, J. L. BACTERIAL FLORA OF AQUARIUM FISHES AND THEIR SHIPPING WATERS IMPORTED FROM SOUTHEAST ASIA. J. Fish. Res. Board Can. 33 (4,1): 732-735. Apr. 1976. In English with French summ. SFA 21(2).
[Dep. Med. Microbiol., Coll. Vet. Med., Univ. Ga., Athens 30602]
Seventy-three plastic containers of aquarium fish and accompanying water from Taiwan, Singapore, Bangkok, and Hong Kong were studied to determine bacterial flora. It was found that 69 percent of the bags of fish contained individuals with bacteremias. When tissue suspensions of fish were examined 18 genera of bacteria were noted. Fourteen genera were found associated with the shipping water. In each case the two predominating organisms encountered were /Pseudomonas/ sp. (not /Aeruginosa/) and /Aeromonas hydrophila/ complex. Other organisms found included /Citrobacter/, /Proteus/, /Escherichia/, /Micrococcus/, /Mycobacterium/, and /Flavobacterium/. Mycoplasmas were not recovered.

76-000805 Shotts, E. B., Jr.; Vanderwork, V. L.; Campbell, L. M. OCCURRENCE OF R FACTORS ASSOCIATED WITH /AEROMONAS HYDROPHILA/ ISOLATES FROM AQUARIUM FISH AND WATERS. J. Fish. Res. Board Can. 33 (4,1): 736-740. Apr. 1976. In English with French summ. SFA 21(2).
[Dep. Med. Microbiol., Coll. Vet. Med., Univ. Ga., Athens 30602]
Isolates obtained from aquarium fish and aquarium waters identified as belonging to the /Aeromonas hydrophila/ complex were examined for the presence of R factors imparting conjugal transmissibility of antibiotic resistance to tetracycline and/or sulfa drugs. It was found that 25.5 percent of the isolates from fish which were resistant to one or more of the screening antibiotics and similarly 14.1 percent of the isolates from aquarium water carried such R factors. These studies suggest that the prophylactic use of tetracycline may be a predisposing factor in the emergence of R factor-carrying strains of bacteria in aquarium water.

76-000806 Souter, B. W.; Sonstegard, R. A.; McDermott, L. A. ENTERIC BACTERIA IN CARP (/CYPRINUS CARPIO/) AND WHITE SUCKERS (/CATOSTOMUS COMMERSONI/). J. Fish. Res. Board Can. 33 (6): 1401-1403. June 1976. In English with French summ. SFA 21(2).
[Fish. Mar. Serv., Freshwater Inst., Winnipeg, MB R3T 2N6, Canada]
Kidneys and intestines of 192 carp (/Cyprinus carpio/) and 49 white suckers (/Catostomus commersoni/) from five different sites in the Great Lakes were examined for enteric bacteria. Bacteria were identified using conventional methods, the New Improved Enterotube, and the API-20E System. In decreasing order of frequency, the 159 enteric bacteria isolated included members of the following genera: /Proteus/ (70), /Enterobacter/ (58), /Providencia/ (12), /Citrobacter/ (11), /Salmonella/ (3), /Serratia/ (3), and /Escherichia/ (2).

PROTOZOAN DISEASES

76-000807 Beckert, H. OBSERVATIONS ON THE BICLOGY OF /ICHTHYOPHTHIRIUS MULTIFILLIS/ (FOUQUET, 1876), ITS SUSCEPTIBILITY TO ETHOXYQUIN, AND SOME IMMUNOLOGICAL RESPONSES OF CHANNEL CATFISH, /ICTALURUS PUNCTATUS/, TO THIS PARASITE. Ph.D. dissertation, Univ. Southwest. La. 198p. 1975. From Diss. Abstr. Int. B Sci. Eng. 36(11), 1976. SFA 21(2).

Trophozoites recovered from channel catfish fingerlings fed a dog food containing ethozyquin produced abnormal, non-infestive tomites. /In vitro/ experiments testing the toxicity of ethoxyquin to tomites, trophozoites, and newly formes cysts indicated that concentrations as low as 7.5 ppm were lethal to the parasites; 5.0 ppm killed approximately one-half of the organisms. Other tests showed that 80 ppm of the chemical are lethal to channel catfish and yellow bullhead fingerlings. Ten ppm of ethoxyquin had no effect on mosquito-fish and young black mollies during a 72-hour test period. Channel catfish feeding experiments in earthen ponds with ethoxyquin-impregnated feed were conducted. The development of parasites collected from these fish was inhibited. Second-generation parasites caused significantly lower infestation rates in other fish.

For immunological experiments, three channel catifsh populations were injected intraperitoneally with 0.1 ml of the /Ichthyophthirius/ antigen and 0.1 ml of complete Freund's adjuvant per fish. Thirty days after injection the fish were bled by cardiac puncture and the sera stored at -23C. Fish injected and bled during optimal temperatures produced protective antibody against the parasite /in vitro/. Sera from these fish produced strong precipitation bands against the antigen in Ouchterlony plates. Fish injected and bled during suboptimal temperatures (15C) produced little or no antibody detectable /in vitro/. Sera from these fish did not produce precipitation bands against the antigen in Ouchterlony plates. However, if these fish were given a 10-day warming up at 23C the original ability to produce antibody was re-established. A minimum of 14 days of optimal temperatures immediately following immunization is probably needed to initiate and maintain antibody production. --From abstr.

VIRAL DISEASES

76-000808 Amend, D. F. PREVENTION AND CONTROL OF VIRAL DISEASES OF SALMONIDS. J. Fish. Res. Board Can. 33 (4,2): 1059-1066. Apr. 1976. In English with French summ. SFA 21(2).

[U.S. FWS, West. Fish Disease Lab., Seattle, WA 98115] Three viral diseases of salmonids are of worldwide concern: infectious pancreatic necrosis (IPN), viral hemorrhagic septicemia (VHS), and infectious hematopoietic necrosis (IHN). Six principal approaches are being used to prevent or control these diseases: 1) preventing contact of the pathogen with the host, 2) environmental manipulation, 3) immunization, 4) chemotherapy, 5) selective breeding for disease resistance, and 6) reducing stress conditions which augment disease conditions. Preventing the introduction of a pathogen into a new stock of fish has been accomplished mainly by implementing stringent laws to prevent transport of infected fish into uninfected areas. Stocks of fish already infected are sometimes destroyed, and the hatchery is disinfected and restocked with fish free of specific pathogens. Environmental manipulation (elevated water temperature) has been successfully used to control IHN. Chemotherapeutics such as povidone-iodine for IPN and benzipyrene for IHN show promise of controlling mortalities; however, the practicality of using these drugs to

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eliminate the carrier fish has not been evaluated. Salmonids are capable of developing immune responses to viruses; however, development of effective vaccines, selective breeding for disease resistance, and identification of stress conditions which augment disease are still in the experimental phase.

76-000809 Appy, R. G.; Burt, M. D. B.; Morris, T. J. VIRAL NATURE OF PISCINE ERYTHROCYTIC NECROSIS (PEN) IN THE BLOOD OF ATLANTIC COD (/GADUS MORHUA/). J. Fish. Res. Board Can. 33 (6): 1380-1385. June 1976. In English with French summ. SFA 21(2).
[Dep. Biol., Univ. New Brunswick, Fredericton, NB E3B 5A3, Canada] Piscine erythrocytic necrosis (PEN), a degenerative disease of erythrocytes of Atlantic cod (/Gadus morhua/), is described at the electron microscope level and compared with light microscope findings. PEN infection is found associated with a cytoplasmic pool of hexagonal particles reminiscent of large icosahedral cytoplasmic deoxyriboviruses (ICDV). Fibrillar strands appear associated with the infection. PEN is compared with other possible ICDV infections in various poikilotherm vertebrates and is considered to be included in a distinct ICDV subgroup which also contains virions associated with infections of /Pirhemocyton/, /Toddia/, rock blenny infections, and perhaps lymphocystis.

76-000810 Bullock, G. L.; Rucker, R. R.; Amend, D.; Wolf, K.; Stuckey, H. M. INFECTIOUS PANCREATIC NECROSIS: TRANSMISSION WITH IODINE-TREATED AND NONTREATED EGGS OF BROOK TROUT (/SALVELINUS FONTINALIS/). J. Fish. Res. Board Can. 33 (5): 1197-1198. May 1976. In English with French summ. SFA 21(2).
[U.S. FWS, East. Fish Dis. Lab., Kearneysville, WV 25430] Experiments conducted simultaneously at two laboratories have shown brook trout (/Salvelinus fontinalis/) egg transmission of the virus of infectious pancreatic necrosis with eggs treated with 100 ppm iodine (as Wescodyne) and with nontreated eggs.

76-000811 McCosker, J. E.; Lagios, M. D.; Tucker, T. ULTRASTRUCTURE OF LYMPHOCYSTIS VIRUS IN THE QUILLBACK ROCKFISH, /SEBASTES MALIGER/, WITH RECORDS OF INFECTION IN OTHER AQUARIUM-HELD FISHES. Trans. Am. Fish. Soc. 105 (2): 333-337. Mar. 1976. SFA 21(2).
[Steinhart Aquarium, Calif. Acad. Sci., San Francisco 94118] Lymphocystis viral infection is reported for the first time from the quillback rockfish, /Sebastes maliger/, the starry rockfish, /S. constellatus/, and the China rockfish, /S. nebulosus/, (family Scorpaenidae), recreationally and commercially important eastern North Pacific species. The ultrastructure of infected cells, herein identified as faculative fibroblasts, of /S. maliger/ is described and illustrated. Other aquarium-held fishes previously unreported as lymphocystis hosts are: /Bodianus mesothorax/, /Chaetodon miliaris/, /C. auriga/, /C. lunulatus/, /Chelmon rostratus/, /Pomacanthus annularis/, and /Cichlasoma synspilum/.

76-000812 Ord, W. M.; Le Berre, M. ; de Kinkelin, P. VIRAL HEMORRHAGIC SEPTICEMIA: COMPARATIVE SUSCEPTIBILITY OF RAINBOW TROUT (/SALMO GAIRDNERI/) AND HYBRIDS (/S. GAIRDNERI/ X /ONCORHYNCHUS KISUTCH/) TO EXPERIMENTAL INFECTION. J. Fish. Res. Board Can. 33 (5): 1205-1208. May 1976. In English with French summ. SFA 21(2).
[Inst. Natl. Rech. Agrar., Lab. Ichtyopathol., 78850 Thiverval-Grignon, France] Rainbow trout (/Salmo gairdneri/) fry and yearlings were compared with hybrids of rainbow trout and coho salmon (/Oncorhynchus kisutch/) for susceptibility to viral hemorrhagic

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septicemia (VHS). In three trials, exposure to waterborne infectivity consistently resulted in a 77 percent mortality of rainbow trout fry while loss among the hybrid fry averaged only 11 percent. Tests showed survivors might be carriers of virus. Hybrid yearlings infected by gill brushing were fully refractory to VHS whereas mortality (3:8) and viremia were recorded among gill-infected rainbow trout yearlings.

OTHER DISEASES AND PARASITES

76-000813 Lindsay, J. A.; Moran, R. L. RELATIONSHIPS OF PARASITIC ISOPODS /LIRONECA OVALIS/ AND /OLENCIRA PRAEGUSTATOR/ TO MARINE FISH HOSTS IN DELAWARE BAY. Trans. Am. Fish. Soc. 105 (2): 327-332. Mar. 1976. SFA 21(2).
[Ecological Analysts, Inc., 600 Wyndhurst Ave., Baltimore, MD 21210] The isopods /Lironeca ovalis/ and /Olencira praegustator/ infest the gill and buccal cavities of at least seven species of fishes taken in the lower Delaware River Estuary. The free-swimming male stages of these two species are external facultative parasites, apparently feeding on lipid substances of the many fishes which serve as intermediate hosts. Both male and female stages of /L. ovalis/ were most prevalent on bluefish, /Pomatomus saltatrix/, which served as both an intermediate and terminal host. Female /L. ovalis/ showed the highest incidence of infestation among bluefish, 19.1 percent; silver perch, /Bairdiella chrysura/, 6.1 percent; white perch, /Morone americana/, 4.1 percent; weakfish, /Cynoscion regalis/, 2.8 percent; and striped bass, /Morone saxatilis/, 1.5 percent. Female /O. praegusta were found only in 0.8 percent of the 590 Atlantic menhaden, /Brevoorti tyrannus/, observed.

76-000814 Nebeker, A. V.; Brett, J. R. EFFECTS OF AIR-SUPERSATURATED WATER ON SURVIVAL OF PACIFIC SALMON AND STEELHEAD SMOLTS. Trans. Am. Fish. Soc. 105 (2): 338-342. Mar. 1976. SFA 21(2).
[U.S. EPA, 1350 S.E. Goodnight Ave., Corvallis, OR 97330] Coho (/Oncorhynchus kisutch/) and sockeye (/O. nerka/) salmon smolts and steelhead trout (/Salmo gairdneri/) smolts were exposed to several concentrations of air-supersaturated water in the laboratory from March through June, 1974, the normal fish migration period in the Columbia River and the time when the river water is usually supersaturated. Tests were conducted at 12 C in water 60 cm deep. Time to 20 percent death was determined and lethal threshold concentrations of 114.5 percent saturation for coho, 113.5 percent for sockeye, and 114.0 percent for steelhead were calculated. Ninety-six hour LC50 values were 120.5 percent for coho, 116.7 percent for sockeye, and 116.0 percent total gas percent saturation for steelhead. Thirty-day LC50 values were 116.2 percent for coho, 113.9 percent for sockeye, and 114.0 percent for steelhead. Severe emphysema (bubbles) occurred on fins, in the mouth, and on the head and opercles of the fish exposed to 120 percent and 115 percent saturation. Emphysema was not as severe at 110 percent but occurred in 60 percent of the coho, 20 percent of the sockeye, and 80 percent of the steelhead.

76-000815 Pippy, J. H. C. LARVAL /ANISAKIS SIMPLEX/ IN ATLANTIC SALMON (/SALMO SALAR/) AND THEIR VALUE AS BIOLOGICAL INDICATORS. Ph.D. dissertation, Univ. Guelph 1975. From Diss. Abstr. Int. B Sci. Eng. 36(12), 1976. SFA 21(2).

Detailed examination of one sample revealed that 60.8 percent of the larvae were in the body cavity or attached to the visceral organs of salmon while the remainder were in the muscles. Studies on numbers of larvae in salmon caught in different areas were based on counts of larvae found in the body cavity or on viscera. The larvae were common in all 14 samples examined (74 percent infected) throughout the North Atlantic. The mean number of larvae per host was higher in salmon from Europe than in those from North America. Annual variations in mean numbers were also observed. Differences in mean numbers were not related to the sex of the host, but were probably related to differences in the feeding habits of the salmon at sea, and possibly to the presence of the tapeworm /Eubothrium crassum/ in the gut.

Differences in morphometry, population genetics, or mean numbers of larval /A. simplex/ could be used as biological indicators in Atlantic salmon to support the following hypotheses concerning stock composition or behavioral characteristics of the hosts: salmon caught off west Greenland are a mixture of stocks from North America and Europe; migratory habits of Scottish salmon in the sea are different from salmon elsewhere in the British Isles; there are varying degrees of mixing of different Canadian salmon stocks within Canadian coastal waters; and the commercial fishery at Labrador is based on locally produced salmon. --From abstr.

76-000816 Templeman, W.; Hodder, V. M.; Fleming, A. M. INFECTION OF LUMPFISH (/CYCLOPTERUS LUMPUS/) WITH LARVAE AND OF ATLANTIC COD (/GADUS MORHUA/) WITH ADULTS OF THE COPEPOD, /LERNAEOCERA BRANCHIALIS/, IN AND ADJACENT TO THE NEWFOUNDLAND AREA, AND INFERENCES THEREFROM ON INSHORE-OFFSHORE MIGRATIONS OF COD. J. Fish. Res. Board Can. 33 (4,1): 711-731. Apr. 1976. In English with French summ. SFA 21(2).

[Queen's Coll., St. John's, NF A1B 3R6, Canada] The lumpfish, /Cyclopterus lumpus/, was found to be a common intermediate host of the larvae of the copepod, /Lernaeocera branchialis/, in the Newfoundland and neighboring areas. Large numbers of these larvae occurred on the gills of lumpfish from inshore Newfoundland areas from the latter half of June to the first half of August, whereas only minor infection was found in any month in offshore areas. Some larvae of the year reached the final or seventh stage on the intermediate host in May on the west coast of Newfoundland and in June on the east coast. By July on the west coast and early August on the east coast, this was by far the most numerous stage present. The larvae were attached mainly near the tips of the gill filaments. Most larvae were attached to the gills of the first two branchial arches, less to those of the third, and much less to those of the fourth. There were more larvae on the right than on the left gills. Infection of the final host Atlantic cod (/Gadus morhua/), by stage-7 female /L. branchialis/ was apparently mainly inshore.

Adult /L. branchialis/ on Atlantic cod, typically located near the anterior ventral apex of the branchial arches, were numerous throughout the year in the areas of high infection. Infection rates of cod with the adult parasite were usually considerably higher near the coast than farther offshore, the rates declining with distance from the coast. Rates of infection with the adult parasite usually increased from the smaller to intermediate cod lengths and declined rapidly at greater lengths. Infection rates were found useful as evidence of inshore and offshore migrations of cod. Infection with the copepod apparently delayed sexual maturity in cod. Most infected cod (86 percent) had one adult copepod and declining numbers (12-0.05

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percent) possessed two to five adult copepods. The Greenland cod, /G. ogac/, was the only other fish of the area found to be highly infected with adult /L. branchialis/.

POLLUTION

76-000817 Boytsov, M. P. THE MORPHOLOGY OF UNDERYEARLING FISHES IN THE ZONE AFFECTED BY WARM WATERS DISCHARGED FROM THE KONAKOVO POWER STATION INTO IVAN'KOVSKOYE RESERVOIR. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (6): 904-910. 1974. SFA 21(2).
[GosNIORKh, Konakovo, USSR] An examination is made of the meristic and morphological characters of underyearlings of the main commercial species from the zone affected by waters discharged from Konokovo power station into Ivan'kovskoye reservoir. These characters are compared with the morphological characteristics of underyearlings from a control bay.

76-000818 Bresnick, G. I. ENVIRONMENTAL EVALUATION OF THE COMBINED EFFECTS OF SEWAGE AND KRAFT PULPMILL EFFLUENTS BASED ON THE RELATIVE GROWTH RATES OF FISHES. Presented at the 39th Annu. Meeting, Am. Soc. Limnol. Oceanogr., Savannah, Ga., June 21-24, 1976. 1976. SFA 21(2)

[Tulane Univ., New Orleans, LA 70118] Physical and chemical water quality parameters and the relative growth rates of fishes were analyzed in a 19 km section of the Pearl River (Louisiana, Mississippi). The mean back claculated standard lengths of /Notropis venustus/ and /Hybognathus nuchalis/ were significantly depressed in populations occupying an area polluted by domestic sewage and kraft pulpmill effluents when compared to populations occupying clean water. No growth depression was found in populations of /Lepomis megalotis/ and /Micropterus salmoides/ occupying polluted water. Sixteen months after the initiation of secondary wastewater treatment by the kraft pulp and papermill growth analyses were repeated on /Notropis venustus/ and /Hybognathus nuchalis/. A significant increase was found in the mean back calculated standard length of age I individuals occupying the polluted area.

76-000819 Galloway, J. N.; Schofield, C. L.; Yost, E.; Likens, G. E. INFLUENCE OF ACID PRECIPITATION ON THE WATER AND SEDIMENT GEOCHEMISTRY OF ADIRONDACK MOUNTAIN LAKES. Presented at the 39th Annu. Meeting, Am. Soc. Limnol. Oceanogr., Savannah, Ga., June 21-24, 1976. 1976. SFA 21(2).
[Cornell Univ., Ithaca, NY 14850] For the last twenty years, precipitation in the northeastern U.S. has been excessively acidic (pH [about] 4.0). Of current concern is the effect of acidic precipitation on poorly buffered aquatic ecosystems such as the high altitude lakes of the Adirondack State Park, New York. Large decreases in pH (from about pH 7 to about 4.5) have been observed in more than one hundred of these lakes during the last thirty years. An investigation on the effect of lake acidification on the distribution of Al, Fe, Mn and Zn in the lake water and sediments of two lakes, one pH 4.7 and the other pH 6.7 shows the following.
(1) The high acidity lake (pH 4.7) had higher (by [about] 10x) dissolved concentrations of Al, Fe, Mn and Zn in the lake water.
(2) The concentration of Al, Fe, Mn and Zn in the sediment of the lower acidity lake (pH 6.7) was constant with depth in the core. The concentrations of the same elements were greatly depleted in the top 10 cms of the core from the lake at pH 4.7. Below the 10 cm level, the

76-000819 CONTINUED
sediment metal concentrations in the lake at pH 4.7 core were approximately equal to those found throughout the length of the core from the lake at pH 6.7.

76-000820 Gardner, W. S.; Windom, H. L.; Kendall, D. R.; Odum, R. R. THE DISTRIBUTION OF METHYLMERCURY IN ORGANISMS AND OTHER COMPONENTS OF A CONTAMINATED SALT MARSH ESTUARINE ECOSYSTEM. Presented at the 39th Annu. Meeting, Am. Soc. Limnol. Oceanogr., Savannah, Ga., June 21-24, 1976. 1976. SFA 21(2).
[Skidaway Inst. Oceanogr., Savannah, GA] Analysis of several species of birds, Mamals, fish and invertebrates collected from a salt marsh ecosystem, which had been industrially contaminated with inorganic mercury, indicated that methyl mercury concentrations were an order of magnitude higher than for similar organisms from non-contaminated regions. Methyl mercury levels were low in sediments and plants (less than 1 ng/g) but accounted for a substantial portion of the mercury in higher trophic level organisms.

76-000821 Hendrey, G. R.; Borgstrom, R.; Raddum, G. ACID PRECIPITATION IN NORWAY: EFFECTS ON BENTHIC FAUNAL COMMUNITIES. Presented at the 39th Annu. Meeting, Am. Soc. Limnol. Oceanogr., Savannah, Ga., June 21-24, 1976. 1976. SFA 21(2).
[Norweigian Inst. Water Res., Oslo, Norway] Invertebrate fauna of Norweigian lakes and streams are severely damaged by acid precipitation. Regional studies of lakes and rivers indicate that species numbers are greatly reduced by low pH in affected water courses. More intensive studies at several lakes confirm these effects and also show that total numbers of organisms and standing crop ($mg/m^2$) are reduced in acidified lakes. Part of the cause is attributed to direct effects of pH on the invertebrates themselves. Another factor, however, appears to be an acid induced food shortage due to pH effects on microbial communities.

76-000822 Hendricks, D. W.; Bluestein, M. H. RESPONSE OF SOUTH PLATTE TO EFFLUENT LIMITATIONS. Proc. Am. Soc. Civ. Eng., J. Environ. Eng. Div. 102 (EE4): 745-768. Aug. 1976. SFA 21(2).
[Dep. Civ. Eng., Colo. State Univ., Ft. Collins, CO 80523] The South Platte river system is typical of many stream systems in the arid west. A computer simulation model was used to project the water quality improvements resulting from implementation of 1977, 1983, and 1985 effluent quality limitation requirements of PL 92-500 for all waste discharges in the basin. Implementation of PL 92-500 will result in continued good quality of waters in the mountains zone. The results of the simulation showed that sufficient improvements of water quality in the plains zone will be achieved by 1983 to permit fish propagation and recreation. However, improvement in water quality alone in the plains zone will result in few benefits at very high cost. Their achievement is essentially precluded by the modifications brought about by intense human uses of the stream and associated lands and by the limiting natural characteristics of the plains system.

76-000823 Jones, R. S.; Randall, R. H.; Wilder, M. J. BIOLOGICAL IMPACT CAUSED BY CHANGES ON A TROPICAL REEF. U.S. Environ. Prot. Agency Ecol. Res. Ser. EPA-600/3-76-027. xiii + 209p. Apr. 1976. SFA 21(2).

[Mar. Lab., Univ. Guam, Agana, Guam 96910] A biological study is conducted on a fringing coral reef adjacent to a thermoelectric power plant on Guam, before and after release of plant effluent. The before study shows corals of the reef front, submarine terrace, and seaward slope to be devastated because of a recent infestation by the crown-of-thorns starfish, /Acanthaster planci/ (L.). The reef margin in found to comprise a rich and diverse coral reef community, presumably spared from /Acanthaster/ attack by strong wave surge. The reef flat is naturally depauperate due to frequent exposure at low tide. Release of plant effluent results in an elevation of water temperature on the adjacent reef flat and reef margin, and wave action exposes even the deeper parts of the reef margin to temperatures above ambient as well as other potentially detrimental effluent parameters such as chlorine and heavy metals. Introduction of the effluent is shown to be responsible for recent destruction of reef margin corals. Effluent is found to stratify beyond the surf zone and is no longer a threat to benthic organisms. Coral transect studies show an increase in recent coral re-colonization on the reef front, terrace and slope since the /Acanthaster/ infestation. No such recovery is evident in benthic habitats of the reef margin, exposed to effluent. Thermal simulation experiments, performed on a series of reef corals in the laboratory, suggest mean upper tolerance limits for the corals between 30 and 33 C. These temperatures are common on the reef margin adjacent to the power plant. Sublethal elevation of temperature is shown to reduce growth rate in some of the coral species. Recommendations are made to release the effluent in deeper water in order to provide a greater mixing zone and to relieve present stress on reef margin organisms.

76-000824 King, J. M.; Ward, C. H.; Characklis, W. G.; Roe, F. L. IMPACT OF WATERSHED DEVELOPMENT ON A RECEIVING STREAM. Presented at the 39th Annu. Meeting, Am. Soc. Limnol. Oceanogr., Savannah, Ga., June 21-24, 1976. 1976. SFA 21(2).

[Rice Univ., Houston, TX 77001] Woodlands, a 17,760 acre urban development located approximately 31 mi. north of Houston, Texas, is being utilized as a study area for investigating the impact of increasing urbanization on a receiving stream. The area has evolved from undisturbed, pine-hardwood forestland to localized developments, such as family dwellings, commercial establishments, and an extensive golf course. Drainage of the watershed is by pre-existing swales and creeks. Collection sites were established along Panther Branch, which drains 80 percent of the watershed. Chemical analyses of low flow water showed increases in nutrient concentrations along the stream, due to urbanization. Analyses of stormwaters, collected at discrete time intervals during stormevents, showed significant influxes of nutrients into Panther Branch. However, as stormwaters receded, nutrient levels decreased to levels approximating those prior to the storm. Nutrient limitation studies indicated that phosphorus was the nutrient most limiting for algal growth in low flow water. However, during periods of surface drainage, nitrogen was the limiting nutrient for algal growth.

76-000825 Rosso, W. A. THE ECOLOGY OF THE SOUTH FORK OF THE SALINE RIVER AS AFFECTED BY SURFACE MINE WASTES. Ph.D. dissertation, South. Ill. Univ. 145p. 1975. From Diss. Abstr. Int. B Sci. Eng. 36(12), 1976. SFA 21(2).

Unaffected river sections had normal pH ranges (6.5-7.5) whereas after the confluence of major acid sources, pH seldom exceeded 4. Iron and manganese showed increases from trace amounts to highs of over 1000 mg/l and 100 mg/l respectively. Sulfate and manganese were found to be useful in detecting the presence of mine drainage. Fifty-nine species of macrobenthic organisms were recorded for the unaffected study section and 8 species were collected from the acid sections. Maximum numbers of riffle organisms recorded at non-acid stations was 25,820/$m^2$ and 8000/$m^2$ was maximum for acid sections. Sixteen taxa of pool bottom organisms were collected from Ekman samples at stations 1 and 2, while five taxa were recorded from acid sections. A maximum of 2280 individuals/$m^2$ and 8750/$m^2$ were recorded for unaffected and acid sections respectively. Riffle fauna of stations 1 and 2 showed little similarity to pool bottom communities of these stations; however riffle and pool bottoms at acid stations showed the same species composition. Twenty-nine taxa of zooplankton and eighteen taxa of phytoplankton were recorded from all stations. Plankton only depicted water quality (acid) after periods of extended low flow conditions. Fish populations were present at stations 1 and 2. Only temporary populations (2 species) were recorded at acid sections. --From abstr.

76-000826 Stanton, G. E. EFFECTS OF WATERSHED URBANIZATION ON BENTHIC MACROINVERTEBRATE COMMUNITIES OF A SMALL STREAM SYSTEM. Presented at the 39th Annu. Meeting, Am. Soc. Limnol. Oceanogr., Savannah, Ga., June 21-24, 1976. 1976. SFA 21(2).

[Columbus Coll., Columbus, GA] Density, diversity, distribution, and stress-indicator associations of benthic macroinvertebrates in a fall-line watershed stream system draining Columbus, GA, were investigated regarding relationships to adjacent watershed land use and development. Comparisons of samples from stream sites associated with rural, recreational, residential, commercial and industrial land uses indicated a significant decline in community diversity and abundance of stress-intolerant indicators, along with an increase in stress-tolerant indicators, as the urbanization of adjacent lands increased. To test the possibility that these differences resulted from a predominance of undeveloped sites being associated with headwaters and developed sites with downstream conditions, invertebrate associations in the tributaries (Flat Rock Ck, Cooper Ck, Lindsey Ck and Weracoba Ck) as well as in the main stream (upper and lower Bull Ck) were compared. No significant differences among community diversities were observed; however, density and percent composition of stress-indicators suggested a decrease in intolerant and an increase in tolerant forms as sampling progressed in a direction opposite to that of the spread of urbanization. Although significant changes were observed for a number of physical and chemical stream characteristics, few, if any, of these environmental conditions would be legally considered at pollution levels. However, analysis of distributions of invertebrates and other biota suggest serious degradation of the stream environment associated with urban development.

FISH KILLS

76-000827 Ingols, R. S. THE CAUSE OF FISH KILLS IN AERATED HYPOLIMNETIC WATER. Presented at the 39th Annu. Meeting, Am. Soc. Limnol. Oceanogr., Savannah, Ga., June 21-24, 1976. 1976. SFA 21(2)

[Ga. Inst. Tech., Atlanta 30332] Large quantities of cold water are scarce near the 34th parallel the year round, for culturing trout. Some large power impoundments, however, have cold hypolimnetic water which is used. The U.S. Department of the Interior uses water from the Greer's Ferry Lake by direct line through the dam to culture rainbow trout near Heber Springs, Arkansas. The water flows over a cascade aerator before contact with the fish. The water quality is fine during the summer, but deteriorates in the Autumn to kill large numbers of fish. While both manganese and hydrogen sulfide are present, the pattern of response to stress indicates that manganese is the dominant toxicant at 1.0 mg/l. A similar loss of trout has occurred along the Chattahoochee River below Lake Lanier at commercial trout fish out ponds. Both manganese and sulfide have been observed in the River, but the fish respond predominantly to the sulfide. The water in both locations is soft; the manganese toxicity can be reduced by increasing the calcium concentration. Permanganate can remove both, but must be closely controlled. A multilevel intake should help at Greer's Ferry. Hydrogen peroxide reduces the sulfide toxicity.

TOXICOLOGY; BIOASSAYS

76-000828 Abernathy, A. R.; Cubie, P. M. MERCURY DYNAMICS IN SOME RECENTLY IMPOUNDED RESERVOIRS IN THE SOUTHEASTERN UNITED STATES. Presented at the 39th Annu. Meeting, Am. Soc. Limnol. Oceanogr., Savannah, Ga., June 21-24, 1976. 1976. SFA 21(2).

[Clemson Univ., Clemson, SC 29631] Mercury levels were determined in largemouth bass (/Micropterus salmoides/) from four reservoirs in the southeastern United States which differ in age, water quality, and trophic state. Mercury levels in bass were highest in the two younger, relatively oligotrophic reservoirs and were significantly lower in two older, more eutrophic reservoirs. Mercury accumulation appears to be related to biological methylation of available trace amounts of mercury in soils which formed the original sediments of the reservoirs. Uptake of mercury by bass in the more oligotrophic systems is enhanced by low availability of nutrients, acidic pH, and low levels of suspended particulate organic matter in the water column. High mercury levels, up to 5 ppm in large bass, are probably a transitory phenomenon in newly impounded reservoirs of high water quality. Mercury levels in fish of these systems may be expected to decline as the reservoirs age, become more eutrophic, and develop reducing sediments with high organic content which will immobilize mercury and make it less available for uptake by fish.

76-000829 Bass, M. L. A STUDY OF LETHALITY AND TOXIC MECHANISMS OF INTERMITTENT CHLORINATION TO FRESHWATER FISH. Ph.D. dissertation, Va. Polytech. Inst. & State Univ. 80p. 1975. From Diss. Abstr. Int. B Sci. Eng. 36(11), 1976. SFA 21(2).

Groups of juvenile bluegill (/Lepomis macrochirus/) were exposed to four total chlorine peak concentrations (0.21, 0.31, 0.42, and 0.52 mg/l) at four temperatures(6, 15, 25, and 32 C) for 7 days. There was no mortality at any of the four temperatures at 0.21 mg/l. There was less than 15 percent lethality at 0.31 mg/l. A concentration of 0.52 mg/l caused 50 percent mortality in less than 75 hours with the higher temperatures causing a shorter time to death. Large (38 cm) rainbow trout (/Salmo gairdneri/) were used to study the physiological effects of intermittent chlorination. During each chlorination, blood PO(2), pH and heart rate decreased while breathing and coughing rates increased. Partial recovery of all parameters occurred after each chlorination but the amount of recovery became progressively less with each pulse. Methemoglobin remained physiologically unchanged and hematocrits increased 48.8 ± 3.0 percent after 3 chlorine pulse exposures. Blood lactate levels showed a gradual increase with successive chlorinations. Gills from bluegills exposed to 0.2 or 0.3 mg/l peak total chlorine showed hyperplasia and swelling of the epithelial cells which caused some blockage of the interlamellar space and thickening of the surface epithelium. The extent of gill damage in the bluegill did not seem to be influenced by the test temperature. Livers from treated bluegill showed characteristic lack of glycogen as compared with control liver. No histological changes were found in either trout or bluegill kidney. It is concluded that the primary mode of action of acute concentrations of chlorine is gill damage resulting in death by asphyxiation. --From abstr.

76-000830 Bender, M. E.; Westman, J. R. THE TOXICITY OF MALATHION AND ITS HYDROLYSIS PRODUCTS TO THE EASTERN MUDMINNOW, /UMBRA PYGMAEA/ (DEKAY). Chesapeake Sci. 17 (2): 125-128. June 1976. SFA 21(2).

[Rutgers Univ., New Brunswick, NJ 08903] The toxicity of malathion and its major hydrolysis products to the eastern mudminnow, /Umbra pygmaea/, was determined by utilizing 4-day static toxicity tests and 14-day continuous flow tests. Four-day LC50 values in mg/l were as follows: malathion 0.24; dimethylphosphorodithioic acid 17; diethyl fumarate 8.5; 2-mercaptodiethylsuccinate 47 and dimethylphosphorothionic acid 26. The basic hydrolysis products proved to be more toxic than the acid hydrolysis products and 14-day continuous flow tests were conducted only on malathion and the basic hydrolysis products. Calculations of field application rates for the pesticide reviewed in light of the toxicity results suggest that only the parent compound, malathoin, poses an environmental hazard to the mudminnow.

76-000831 Birkeland, C.; Reimer, A. A.; Young, J. R. SURVEY OF MARINE COMMUNITIES IN PANAMA AND EXPERIMENTS WITH OIL. U.S. Environ. Prot. Agency. Ecol. Res. Ser. EPA-600/3-76-028. xv + 177p. May 1976. SFA 21(2).

[Smithsonian Trop. Res. Inst., Balboa, Canal Zone] Baseline surveys were conducted on both the Caribbean and Pacific coasts of Panama. The structure of macroinvertebrate communities alcng the Caribbean transect are presented from data collected for over 500 identified species in 108 samples including a total of over 50,000 specimens. Recruitment to benthic communities was investigated with settling plates. The Caribbean was found to be seasonal in species occurrence while the Pacific was seasonal in productivity. The effects of oil pollution on tropical intertidal marine communities were tested by precisely controlled experiments unilizing tarry Bunker C and volatile

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marine diesel oils. Field experiments were performed on a Caribbean intertidal reef flat community, a Pacific rocky shore community, settling plates in both oceans, mangrove trees sprayed with oil on the leaves and/or stilt roots and on coral growth. Bunker C oil had a greater detremental effect than did marine diesel oil on coral growth. Marine diesel oil has a greater detrimental effect than did Bunker C oil on fouling communities of settling plates. When comparing experimentals with controls, growth rates were used as an indicator of the presence of unobserved physiological stress or damage and a quantitative index of the cost of repair. Susceptibility to oil pollution vaired significantly between individuals. The growth rates of corals differed significantly with location and time of year so that very precise controls were required in the experiments.

76-000832 Bouck, G. R.; Nebeker, A. V.; Stevens, D. G. MORTALITY, SALTWATER ADAPTATION AND REPRODUCTION OF FISH DURING GAS SUPERSATURATION. U.S. Environ. Prot. Agency Ecol. Res. Ser. EPA-600/3-76-050. ix + 55p. May 1976. SFA 21(2).
[U.S. EPA, Corvallis Environ. Res. Lab., Corvallis, OR 97330] Tests were conducted using continuous exposure in shallow water at levels of total dissolved gas pressure ranging from 110-140 percent of barometric pressure (hyperbaric pressure = 103-410 g/cm$^2$). Both times to 20 percent and to median mortality were determined on several life stages of Pacific salmonids (/Oncorhynchus/ and /Salmo/) and largemouth bass (/Micropterus salmoides/). Mean times to 20 percent mortality at 115 percent total gas saturation were 309, 154, and 125 hours for adults, smolts and parr. At 120 percent saturation mean times to 20 percent mortality were 48, 41, and 53 hours for adults, smolts, and parr. At 125 percent saturation, mean times to 20 percent mortality decreased to 18, 17, and 24 hours for adults, smolts, and parr. Factors which influence time to death included genera, life stage, acclimation temperature, activity level, sex, and body size. Mortality curves were typically skewed to the right. Gross pathology of gas bubble disease was described relative to these experiments. High gas levels that killed 50 percent of three species of salmon smolts had no apparent effect on the ability of survivors to tolerate an immediate transfer into seawater (30 ppt Cl). Long-term (3-month) continuous exposure of adult spring chinood salmon to 110 percent saturation had no readily apparent adverse impact on the fertilization and hatching of their eggs.

76-000833 Buchanan, D. V.; Tate, P. S.; Moring, J. R. ACUTE TOXICITIES OF SPRUCE AND HEMLOCK BARK EXTRACTS TO SOME ESTUARINE ORGANISMS IN SOUTHEASTERN ALASKA. J. Fish. Res. Board Can. 33 (5): 1188-1192. May 1976. In English with French summ. SFA 21(2).
[Alaska Dep. Fish Game, Petersburg 99833] Sitka spruce bark extracts were found to be toxic to adult and larval pink shrimp (/Pandalus borealis/) and larval Dungeness crab (/Cancer magister/). Sitka spruce and western hemlock bark extracts were found to be toxic to pink salmon (/Oncorhynchus gorbuscha/) fry. For salmon fry, toxic effects were observed as soon as 3 h after exposure to hemlock bark extracts. After a 96-h exposure, 50 percent of the test fry were killed at a concentration of 56 mg/liter (96-h LC50). With a 96-h exposure of spruce extracts, 50 percent of the fry were killed at concentrations of 100-120 mg/liter.
Spruce bark extracts were consistently toxic to all invertebrates tested. The 96-h LC50 with larval shrimp, adult shrimp, and larval crabs were 415, 205, and 530 mg/liter, respectively. Using loss of swimming as the criterion, the 96-h EC50s for larval shrimp and larval crabs were 155 and 255 mg/liter, respectively (EC50: median effective concentration). Spruce bark pulp was found to be 2-6 times more toxic

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than extracts to shrimp larvae.

76-000834 Buckley, J. A.; Whitmore, C. M.; Matsuda, R. I. CHANGES IN BLOOD CHEMISTRY AND BLOOD CELL MORPHOLOGY IN COHO SALMON (/ONCORHYNCHUS KISUTCH/) FOLLOWING EXPOSURE TO SUBLETHAL LEVELS OF TOTAL RESIDUAL CHLORINE IN MUNICIPAL WASTEWATER. J. Fish. Res. Board Can. 33 (4,1): 776-782. Apr. 1976. In English with French summ. SFA 21(2).

[Water Qual. Lab., Munic. Metrop. Seattle, Seattle, WA 98104] Yearling coho salmon (/Oncorhynchus kisutch/) were exposed for 12 wk to either 0.3, 1.1, or 3.6 percent chlorinated municipal sewage treatment plant effluent with seawater diluent (average salinity 28°/oo) under conditinuous flow conditions. The maximum safe concentration of effluent lies between 0.3 and 1.1 percent (average total residual chlorine (TRCl(2) content 0.003 and 0.009 mg/liter, respectively). Effluent concentrations of 0.3 percent produced no discernible effects on the fish. Concentrations of 1.1 and 3.6 percent (average content of TRCl(2) 0.030 mg/liter) resulted in reductions of hemoglobin and hematocrit to levels indicative of anemia. Observations of the erythrocytes revealed lysed and degenerating cells, increased numbers of circulating immature cells, and abnormal cells. These hematological effects are attributed to the oxidative nature of TRCl(2).

76-000835 Bulkley, R. V.; Kellogg, R. L.; Shannon, L. R. SIZE-RELATED FACTORS ASSOCIATED WITH DIELDRIN CONCENTRATIONS IN MUSCLE TISSUE OF CHANNEL CATFISH /ICTALURUS PUNCTATUS/. Trans. Am. Fish. Soc. 105 (2): 301-307. Mar. 1976. SFA 21(2).

[Iowa Coop. Fish. Res. Unit, Iowa State Univ., Ames 50010] Dieldrin concentrations in muscle tissue of channel catfish, /Ictalurus punctatus/, from the Des Moines River, Iowa were compared in relation to body total length, age, sex, and fat content. Residue levels were not consistently related to any single size-related variable.

76-000836 Cardwell, R. D.; Foreman, D. G.; Payne, T. R.; Wilbur, D. J. ACUTE TOXICITY OF SELECTED TOXICANTS TO SIX SPECIES OF FISH. U.S. Environ. Prot. Agency Ecol. Res. Ser. EPA-600/3-76-008. viii + 117p. Mar. 1976. SFA 21(2).

[Chemico Process Plants Co.-Envirogenics Systems, El Monte, CA 91734] The relationship between median lethal concentration and exposure time was determined for five chemicals and up to six species of freshwater fish in a flow-through system. The lowest median lethal concentrations found were 0.114 mg/l for sodium cyanide, 0.118 mg/l for sodium pentachlorophenate, 2.9 mg/l for selenium dioxide, 18.0 mg/l for sodium arsenite, 25.4 mg/l for beryllium sulfate, and greater than 100 mg/l for lead chloride.

Toxicity curves relating median lethal concentrations to exposure time were of three types. One curve, resembling a rectangular hyperbola, characterized the toxicity of sodium cyanide, while another curve, sigmoid in shape, characterized the toxicity of selenium dioxide. Both types of curves were observed in toxicity tests with sodium pentachlorophenate, sodium arsenite and beryllium sulfate. Linear toxicity curves were recorded for some fish species exposed to selenium dioxide, sodium arsenite and beryllium sulfate, but these were usually encountered when exposure times were less than 96 hr.

76-000837 Davis, K. B.; Simco, B. A. SALINITY EFFECTS ON PLASMA ELECTROLYTES OF CHANNEL CATFISH, /ICTALURUS PUNCTATUS/. J. Fish. Res. Board Can. 33 (4,1): 741-746. Apr. 1976. In English with French summ. SFA 21(2).

[Dep. Biol., Ecol. Res. cent., Memphis State Univ., Memphis, TN 38152] Plasma sodium and chloride levels of channel catfish (/Ictalurus punctatus/) increased after a 5-day exposure to 10 and 12 g/liter sodium chloride. Exposure of fish to 4 and 8 g/liter for 5 days resulted in plasma electrolyte levels higher than those of fish kept in aged tap water, but were not different from values usually found in freshwater fish. These observed differences may have been due to handling. Tests were performed during several months and no effect due to season was observed.

When fish in July (27 C) were exposed to 10 g/liter sodium chloride, the plasma electrolyte concentration increased for 48 h and then stabilized. Exposure to the same concentration in March (9 C) resulted in a slow increase of plasma electrolytes throughout the 13 days of the experiment. Injection of 100 ug/kg cortisol had no effect on plasma electrolyte increase during 48 h after transfer to 12 g/liter sodium chloride.

76-000838 de Jong, I. G.; Wiles, D. R. MOLECULAR ACTIVATION ANALYSIS AND ITS APPLICATION TO METHYLMERCURY DETERMINATION IN VARIOUS MARINE SAMPLES. J. Fish. Res. Board Can. 33 (6): 1324-1330. June 1976. In English with French summ. SFA 21(2).

[Chem. Dep., Carleton Univ., Ottawa, ON K1S 5B6, Canada] A novel method is described by which nuclear activation analysis can be used to determine the chemical form in which certain elements occur. The radiochemical retention of molecular identity is constant for a given type of sample and can be easily determined. Application of this method for quantitative estimation of methylmercury in fish protein concentrates and in blood is described in detail and the results discussed. The results are reliable and reproducible. Radiochemical retention depends on the species of fish, perhaps because of gamma radiolysis of the sample. An alternative method is also described which, although less direct, is free from many of the common interferences, such as sodium and phosphorus. This method, also useful for blood analysis is appropriate for use at remote sampling stations.

76-000839 Doudoroff, P. TOXICITY TO FISH OF CYANIDES AND RELATED COMPOUNDS. A REVIEW. U.S. Environ. Prot. Agency Ecol. Res. Ser. EPA-600/3-76-038. vi + 155p. Apr. 1976. SFA 21(2).

[Dep. Fish Wildl., Oreg. State Univ., Corvallis 97331] The world literature on the toxicity to fish of simple and complex cyanides, nitriles, cyanogen chloride, thiocyanates, and cyanates is reviewed critically and interpretively. Differently determined limits of toxicant concentrations tolerated by various fishes are compared, and their variation with exposure time, the pH, temperature, and dissolved oxygen and mineral content of the water, body size, age, acclimation, etc., is examined. Interactions of free cyanide with other toxic water pollutants also are considered. Available data on effects of sublethal levels of free cyanide on growth, food consumption and utilization, swimming ability, behavior, etc., and observations on avoidance reactions of fish to the toxicant are summarized and their ecological significance is discussed. After a brief introduction to the chemistry of complex metallocyanides and their behavior in dilute solutions, the acute toxicity of the solutions is thoroughly considered and related to concentrations of their identifiable components. The dominant role of molecular hydrocyanic acid produced by disscciation or photolysis of the metallocyanide complexes as a lethal agent responsible for the toxicity of most of the toxic solutions tested is given particular

76-000839 CONTINUED
attention; the relative toxicity of complex metallocyanide ions also is considered. Some conclusions regarding acceptable concentrations of free cyanide in receiving waters are presented.

76-000840 Elwood, J. W.; Eyman, L. D. TEST OF A MODEL FOR PREDICTING THE BODY BURDEN OF TRACE CONTAMINANTS IN AQUATIC CONSUMERS. J. Fish. Res. Board Can. 33 (5): 1162-1166. May 1976. In English with French summ. SFA 21(2).

[Environ. Sci. Div., Oak Ridge Natl. Lab., Oak Ridge, TN 37830] A model for predicting the accumulation and retention of trace contaminants obtained through food ingestion in aquatic consumers was tested for short-term exposure conditions. Model parameters were determined in a single-feeding experiment using bluegill (/Lepomis macrochirus/) and food labeled with $^{137}Cs$. Independent of this single-feeding experiment, bluegill were allowed to ingest $^{137}Cs$ contaminated food over a 16-day and the predicted and measured body burden of the period radionuclide were compared. The model realistically simulated the absorption of $^{137}Cs$ from the gastrointestinal tract and its accumulation over the 16-day period. Average body burden of $^{137}Cs$ in bluegill was within 25 percent of the predicted body burden when the experiment was terminated. Apparent equilibrium of $^{137}Cs$ in bluegill by day 16 suggests that this two-compartment linear model does not apply to the long-term accumulation of cesium in fish. The model appears most applicable for predicting body burdens of trace contaminants under acute exposure conditions that simulate an accidental release.

76-000841 Fava, J. A., Jr. THE BEHAVIORAL RESPONSES OF BLACKNOSE DACE, /RHINICHTHYS ATRATULUS/ (HERMANN), TO DOMESTIC SEWAGE EFFLUENTS AND THEIR TOXIC CONSTITUENTS. Ph.D. dissertation, Univ. Md. 126p. 1975. From Diss. Abstr. Int. B Sci. Eng. 36(10), 1976. SFA 21(2).

The ability of 222 blacknose dace to detect and avoid domestic sewage effluents and their toxic constituents of free chlorine, chloramines and ammonia was investigated in the laboratory. Although the fish did not immediately avoid either unchlorinated sewage effluents or effluents chlorinated to 0.18 mg/l total chlorine, they did avoid chlorinated sewage effluents at 0.51 mg/l, 0.87 mg/l, and 1.52 mg/l total chlorine. In chloramine solutions and in chlorinated sewage effluents the avoidance by the fish were identical; and occurred in each at a lower concentration than in free chlorine solutions. Swimming activity was unaffected by either chlorinated sewage effluents or chloramine solutions, but was reduced by free chlorine solutions. The fish did not avoid solutions containing ammonia-nitrogen as high as 270 mg/l. The fish showed a delayed avoidance to free chlorine and chloramine solutions as low as 0.07 mg/l total chlorine. The median avoidance time, calculated for chloramine and free chlorine solutions, proved to be shorter than the median survival time at the same concentration of total chlorine in each solution. This indicates that the fish can detect and avoid each solution before being killed by it. Experiments concerning the role of memory of previous experiences in free chlorine solutions of 0.17 mg/l were inconclusive. This study indicates that chloramines are the major cause of avoidance, by the fish, of chlorinated sewage effluents. This may explain the absence of fish below sewage outfalls in streams, without evidence of fish kills. --From abstr.

76-000842 Hansen, C. R., Jr.; Kawatski, J. A. APPLICATION OF 24-HOUR POSTEXPOSURE OBSERVATION TO ACUTE TOXICITY STUDIES WITH INVERTEBRATES. J. Fish. Res. Board Can. 33 (5): 1198-1201. May 1976. In English with French summ. SFA 21(2).

[Dep. Biol., Viterbo Coll., La Crosse, WI 54601] Experimentation with carbaryl, dieldrin, endothal, malathion, and TFM (3-trifluoromethyl-4-nitrophenol) on the ostracod /Cypretta kawatai/ and the midge /Chironomus tentans/ demonstrated that the method of routine toxicity tests wtih invertebrates can be substantially improved by including a posttreatment (toxicant-free water) observation period. This improvement enables confirmation of death and thereby reveals latent toxicity or recovery.

76-000843 Hansen, L. G.; Wiekhorst, W. B.; Simon, J. EFFECTS OF DIETARY AROCLOR 1242 ON CHANNEL CATFISH (/ICTALURUS PUNCTATUS/) AND THE SELECTIVE ACCUMULATION OF PCB COMPONENTS. J. Fish. Res. Board Can. 33 (6): 1343-1352. June 1976. In English with French summ. SFA 21(2).

[Coll. Vet. Med., Univ. Ill., Urbana 61801] Channel catfish (/Ictalurus punctatus/) fingerlings fed a diet containing 20 ppm Aroclor 1242 for 20 wk responded with a reduced weight gain and liver hypertrophy when compared to controls. When treated fish were fed the control diet for 8 subsequent wk followed by 8 additional wk of Aroclor feed, they approached control values for liver weight and surpassed the rate of gain for control fish. No histopathological lesions were observed in the fish fed PCB. The total PCB in fish declined slightly during an 8-wk PCB-free period beginning at week 12, but the PCB burden remained constant when the PCB-free period was begun at week 20. During PCB-free periods, there was a shift in residues from the edible carcass to the offal. Residues are discussed as components as well as total PCB. We found that a tetrachlorobiphenyl is more persistent than some higher chlorinated components and that various tissues accumulated different profiles of components.

76-000844 Hodson, P. V. TEMPERATURE EFFECTS ON LACTATE-GLYCOGEN METABOLISM IN ZINC-INTOXICATED RAINBOW TROUT (/SALMO GAIRDNERI/). J. Fish. Res. Board Can. 33 (6): 1393-1397. June 1976. In English with French summ. SFA 21(2).

[Dep. Zool., Univ. Guelph, Guelph, ON, Canada] Acute, lethal exposures of fish to zinc cause gill damage and subsequent death through tissue hypoxia. This experiment showed that lactic acid production and glycogen utilization in dorsal white muscle of rainbow trout (/Salmo gairdneri/) increased with time of exposure to a lethal concentration of zinc. Exposure of trout to zinc at 3, 11, and 19 C did not affect the timing or percentage change of lactic acid production or utilization of glycogen. Therefore, the previously observed high tolerance of zinc by warm-acclimated fish is not due to increased resistance to the tissue hypoxia caused by gill damage.

76-000845 Houston, A. H.; Corlett, J. T.; Woods, R. J. SPECIMEN WEIGHT AND M.S. 222. J. Fish. Res. Board Can. 33 (6): 1403-1407. June 1976. In English with French summ. SFA 21(2).

[Dep. Biol. Sci., Brock Univ., St. Catharines, ON L2S 3A1, Canada] The influence of specimen weight upon induction of and recovery from Stage I M.S. 222 (ethyl /m/-aminobenzoate methanesulphonate) was examined in goldfish (/Carassius auratus/), brook (/Salvelinus fontinalis/), and rainbow trout (/Salmo gairdneri/) exposed to various anesthetic concentration-temperature combinations. Both induction and recovery times varied inversely with weight, the influence of weight

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being particularly pronounced among smaller specimens. These observations are consistent with the hypothesis that attainment of "critical" internal anesthetic concentration is influenced by weight-specific variation in the relationship between gill area and extracellular phase volume.

76-000846 Kennedy, V. S. ARSENIC CONCENTRATIONS IN SOME COEXISTING MARINE ORGANISMS FROM NEWFOUNDLAND AND LABRADOR. J. Fish. Res. Board Can. 33 (6): 1388-1393. June 1976. In English with French summ. SFA 21(2).

[Fish. Mar. Serv., Biol. Stn., St. John's, NF A1C 1A1, Canada] Inorganic arsenic concentrations in sea water and mud, and total arsenic concentrations in bodies of shrimp, zooplankton, and fish from northern Newfoundland and southern Labrador were measured. There was a positive relationship between concentration and carapace length in /Pandalus borealis/ and /P. montagui/ and a negative relationship in /Eualus macilentus/. There was no relationship between concentrations in shrimp eggs and carapace length. Arsenic concentrations in zooplankton and fish muscle were relatively low compared with the shrimp species; amphipods contained more arsenic than copepods or euphausiids, and American plaice (/Hippoglossoides platessoides/) more than redfish (/Sebastes marinus/), turbot (/Reinhardtius hippoglossoides/), and Atlantic cod (/Gadus morhua/). There was no evidence of increasing arsenic concentrations through successively higher levels of the food chain.

76-000847 Khattat, F. H.; Farley, S. ACUTE TOXICITY OF CERTAIN PESTICIDES TO /ACARTIA TONSA/ DANA. U.S. Environ. Prot. Agency Ecol. Res. Ser. EPA-600/3-76-033. viii + 29p. May 1976. SFA 21(2).

[Hazleton Lab., Vienna, VA 22180] The acute toxicity to the marine copepod /Acartia tonsa/ Dana of four technical grade insecticides was determined by bioassay using standardized procedures, homogenous populations and constant laboratory conditions. At a water temperature of 17 ±1 C, the 96-hour median lethal concentrations or tolerance limits for methyl parathion, Azodrin, diazinon and toxaphene were computed as 0.89 milligrams per liter, 0.24 milligrams per liter, 2.57 micrograms per liter and 7.2 nanograms per liter, respectively. Residue analysis for diazinon at zero and 96-hour exposure time revealed that the amounts of diazinon uptake by three algal organisms is greater than amounts concentrated by the copepod. The toxicity of higher concentrations above 2.0 ppm (2 milligrams per liter) has offset copepod uptake, while at lower concentrations, quantities concentrated by /Acartia/ are negligible.

Concurrently, the world literature was surveyed for supporting toxicity data of these chemicals to closely related species.

76-000848 Klaverkamp, J. F.; Lockhart, W. L.; Metner, D.; Grift, N. EFFECTS OF CHRONIC DDT/DDE EXPOSURE ON ANESTHETIC INDUCTION AND RECOVERY TIMES IN RAINBOW TROUT (/SALMO GAIRDNERI/). J. Fish. Res. Board Can. 33 (6): 1331-1334. June 1976. In English with French summ. SFA 21(2).

[Fish. Mar. Serv., Freshwater Inst., Winnipeg, MB R3T 2N6, Canada] In rainbow trout (/Salmo gairdneri/) fed pellets containing 4.55 ug/g of p,p'-DDT and 6.81 ug/g of p,p'-DDE every other day, anesthetic induction and recovery times of phenoxyethanol (PE) were less than those in trout fed control pellets. No interactions were observed in fish fed DDT/DDE and anesthetized with ethyl /m/-aminobenzoate methanesulphonate (M.S. 222). Differences observed between fish fed DDT/DDE and anesthetized with PE and compared to M.S. 222 could be due either to enhanced metabolism of PE or to the fact that PE and M.S.

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222 have different modes or sites of action.

76-000849 Laarman, P. W.; Willford, W. A.; Olson, J. R. RETENTION OF MERCURY IN THE MUSCLE OF YELLOW PERCH (/PERCA FLAVESCENS/) AND ROCK BASS (/AMBLOPLITES RUPESTRIS/). Trans. Am. Fish. Soc. 105 (2): 296-300. Mar. 1976. SFA 21(2).

[Mich. Dep. Nat. Resour., Fish. Div., Ann Arbor 48104] Mercury-contaminated yellow perch (/Perca flavescens/) and rock bass (/Ambloplites rupestris/) were collected from Lake St. Clair and stocked in two earthen ponds in September 1970. Twenty-six months later, concentrations of total mercury in the fillets had declined 53 percent in the yellow perch and 59 percent in the rock bass; however, the mean weight of the fish increased 88 and 183 percent, respectively, during the same period. All of the reduction in mercury concentrations was attributable to dilution by growth. Slight discrepancies between the theoretical and observed reduction of mercury concentrations suggest an initial redistribution of residues from other tissues to the muscle and a continued incorporation of background amounts of mercury during growth.

76-000850 Lett, P. F.; Farmer, G. J.; Beamish, F. W. H. EFFECT OF COPPER ON SOME ASPECTS OF THE BIOENERGETICS OF RAINBOW TROUT (/SALMO GAIRDNERI/). J. Fish. Res. Board Can. 33 (6): 1335-1342. June 1976. In English with French summ. SFA 21(2).

[Fish. Mar. Serv., Biol. Stn., St. Andrews, NB E0G 2X0, Canada] The influence of sublethal concentrations of total copper on the appetite, growth, and proximate body composition of rainbow trout (/Salmo gairdneri/) held in hard water (365 mg/liter) was measured over a 40-day interval. The initial response of trout exposed to concentrations of copper ranging from 0.0 to 0.3 mg/liter (the 96-h LC50 was 0.25-0.68) was the cessation of feeding. Thereafter, food intake gradually returned to amounts observed for control fish, the rate of return of appetite being dependent on copper concentration and ration level. Growth rate of trout exposed to copper (0.075-0.225 mg/liter) and fed rations of either 0.25 or 1.5 percent dry food wt/wet fish wt per day was initially depressed but approached values observed for control fish near the end of the 40-day interval. During this period, lipid, protein, and moisture of fish exposed to copper did not change significantly. Initial growth retardation was not attributable to the inability of copper-exposed fish to digest their daily rations. Results are discussed in terms of the ability of fish to adapt to stress imposed by sublethal concentrations of heavy metals.

76-000851 Marinenko, G.; Huggett, R. J.; Friend, D. G. AN INSTRUMENT WITH INTERNAL CALIBRATION FOR MONITORING CHLORINE RESIDUALS IN NATURAL WATERS. J. Fish. Res. Board Can. 33 (4,1): 822-826. Apr. 1976. In English with French summ. SFA 21(2).

[Natl. Bur. Standards, Washington, DC 20234] To increase the sensitivity of field instruments for measurement of low level chlorine concentrations in natural waters a new monitor was developed. Iodine, resulting from oxidation of potassium iodide by chlorine residual, is measured amperometrically in a system in which coulometrically generated iodine is used as a system calibrant. Laboratory tests, field tests, and comparisons of the new chlorine monitor with other instruments were performed. Data obtained with the new instrument show that chlorine concentrations down to a few parts per billion can be measured. The instrument is portable, and has built-in electrical calibration features and direct read-out display in either microamperes or parts per million of residual chlorine.

76-000852 Matey, V. Ye. FUNCTIONAL STATE OF THE HYPOTHALAMO-HYPOPHYSIAL NEUROSECRETORY SYSTEM OF THE GUPPY, /LEBISTES RETICULATUS/, WITH ACUTE POLYCHLORPINENE POISONING. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (1): 132-138. 1975. SFA 21(2).
[USSR Acad. Sci., Borok, Yaroslavl Province, USSR] The functional state of the hypothalamo-hypophysical neurosecretory system (HHNS) of the guppy, /Lebistes reticulatus/, exposed in the course of 23 hours to the acute action of polychlorpinene in a lethal concentration of 12.7 mg/liter is described. It was demonstrated that the response of the HHNS of the guppy to the action of polychlorpinene is not specific but is of a general nature characteristic of reactions to other stress effects. Four phases are distinguished in the response reaction of the HHNS of the guppy to toxic action. During the ccurse of the experiment a gradual decrease occurs in the amount of neurosecretion in the HHNS, leading to complete exhaustion of the system and the death of the fish.

76-000853 May, R. C. EFFECTS OF SALTON SEA WATER ON THE EGGS AND LARVAE OF /BAIRDIELLA ICISTIA/ (PISCES: SCIAENIDAE). Calif. Fish Game 62 (2): 119-131. Apr. 1976. SFA 21(2).
[Hawaii Inst. Mar. Biol., P.O. Box 1346, Kaneohe 96744] In laboratory experiments, eggs and early larvae of the sciaenid fish /Bairdiella icistia/ survived well in sea water but displayed extremely poor survival in water from the Salton Sea. Mortality in Salton Sea water was expressed mainly among hatched larvae prior to complete yolk absorption. Experiments conducted in both natural and artificial sea water and Salton Sea water indicated that this poor survival was related to the unusual ionic composition of the Salton Sea.

76-000854 McCormick, J. H. TEMPERATURE EFFECTS ON YOUNG YELLOW PERCH, /PERCA FLAVESCENS/ (MITCHILL). U.S. Environ. Prot. Agency Ecol. Res. Ser. EPA-600/3-76-01957. vi + 19p. May 1976. SFA 21(2).
[U.S. EPA, Environ. Res. Lab., Duluth, MN 55804] The effect of temperature on growth of young-of-the-year yellow perch was determined over an 8-week period at constant temperatures from 8 to 34 C. Absolute growth rates peaked at 28 C, but were not significantly less (P greater than 0.05) over the range from 26 to 30 C. Deformities occurred at 32 C but at no lower temperatures, and all fish died within 7 days at 34 C. A suggested seasonal temperature cycle for yellow perch habitats is presented, based on the data from this experiment for the summer period of rapid growth and on data from previous studies for other life stages.

76-000855 McLeay, D. J. A RAPID METHOD FOR MEASURING THE ACUTE TOXICITY OF PULPMILL EFFLUENTS AND OTHER TOXICANTS TO SALMONID FISH AT AMBIENT ROOM TEMPERATURE. J. Fish. Res. Board Can. 33 (6): 1303-1311. June 1976. In English with French summ. SFA 21(2).
[Div. Appl. Biol., B. C. Research, Vancouver, BC V6S 2L], Canada] A residual oxygen bioassay performed at ambient room temperature is examined as a rapid method for measuring the acute toxicity of pulpmill effluents and other toxicants to salmonid fish. Test results are evaluated in comparison with 96-h LC50 bioassays.
At test temperatures of 19-22 C and coho salmon (/Oncorhynchus kisutch/) loadings of 4-5 g/liter, residual oxygen levels were elevated in effluent concentrations equivalent to 0.5-0.9 of the samples' 96-h LC50 values; these tests were completed within 5-6.5 h. Sensitivity increased only slightly with a loading of 1 g/liter and this test required 18 h for completion. Decreasing the number of fish

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per jar from 4 to 1 while holding fish loadings constant by varying the size of the test containers did not alter the test's sensitivity. Results indicate that, with a loading of 4-5 g fish/liter and 10 replicates of 1 fish/jar, a residual oxygen bioassay at ambient room temperature is more sensitive than a 96-h LC50 batch replacement bioassay (2 liters/g fish per day). Under these conditions fish requirements are identical; the residual oxygen test is completed within 6.5 h and 32- to 40-fold reduction in volume of test solutions required is achieved.

The procedure was evaluated with rainbow trout (/Salmo gairdneri/) using dehydroabietic acid, zinc, phenol, and lindane. Significant responses occurred with these toxicants at concentrations equivalent to 0.5-1.0 of the samples' 96-h LC50 values and higher.

76-000856 Pedersen, M. G.; Hershberger, W. K.; Zachariah, P. K.; Juchau, M. R. HEPATIC BIOTRANSFORMATION OF ENVIRONMENTAL XENOBIOTICS IN SIX STRAINS OF RAINBOW TROUT (/SALMO GAIRDNERI/). J. Fish. Res. Board Can. 33 (4,1): 666-675. Apr. 1976. In English with French summ. SFA 21(2).

[Wash. State Dep. Fish., Fish. Cent. WH-10, Univ. Wash., Seattle 98195] Six strains of rainbow trout (/Salmo gairdneri/), each geographically and genetically distinct, were compared in relation to their capacity for hepatic hydroxylation of aniline and benzo[a] pyrene, and reduction of /p/-nitrobenzoic acid to /p/-aminobenzoic acid, in vitro. The effects of 3-methylcholanthrene on stimulation of nitro reductase and aryl hydrocarbon hydroxylase were examined. For the three systems studied, a significant pattern was observed with respect to each strain's capacity for metabolism. Induction experiments suggested that environment may influence gene expression. Enzyme kinetics and spectral properties were also examined, and mechanisms causing variability within and among strains were discussed.

76-000857 Pegg, W. J.; Keller, E. C., Jr.; Harner, E. J. THE INFLUENCE OF ACID ON THE CYCLIC NATURE OF OXYGEN CONSUMPTION IN VARIOUS FISHES. Proc. W. Va. Acad. Sci. 48 (1): 29. 1976. Abstract only. SFA 21(2).

[Dep. Biol., Frostburg State Coll., Frostburg, MD 21532] Oxygen consumption rates were measured in the brown bullhead, /Ictalurus nebulosus/ (Le Sueur); pumpkinseed sunfish, /Lepomis gibbosus/ (Linnaeus); and bluegill sunfish, /Lepomis macrochirus/ Rafinesque. The types of water examined were: 1) city tap water; 2) constituted river water, acidified with sulfuric acid; 3) constituted river water, acidified with mine drainage; and 4) city tap water, acidified with sulfuric acid. Oxygen consumption rates were determined as the differences between inflow and outflow estimates of dissolved oxygen, adjusted by fish biomass. The measurements were made with a dissolved oxygen probe in a continuous flow respirometer at 20 ± 1 C. The experimental runs were completed over 48, 72, or 96 hour intervals.

Brown bullheads and bluegill sunfish exhibited depressed average oxygen consumption rates in acid waters as compared to control rate levels (determined in tap water). Pumpkinseed sunfish exhibited higher average rates of oxygen consumption in acid waters than in the tap water control.

Cyclic fluctuation in the oxygen consumption rate of all three species appeared to be altered in both frequency and amplitude by the presence of acid water.

76-000858 Persov, G. M.; Shirokova, T. V. THE REPRODUCTIVE FUNCTION OF /TILAPIA MOSSAMBICA/ DURING THE POSTRADIATIVE PERIOD IN THE THIRD GENERATION. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 15 (1): 55-61. 1975. SFA 21(2).

[Biol. Inst., Leningrad State Univ., Leningrad, USSR] The influence of small doses of radiation (350 r) on certain indicators which characterize the function of the reproductive system of /Tilapia mossambica/ is considered. This influence may be either stimulating or inhibiting, depending on the initial state of the sex gland at the time of irradiation. The influence of radiation was observed throughout three generations. As a possible explanation of the results obtained, a hypothesis is advanced, based on concepts of disintegration of the endocrine system by radiation in early ontogenesis and on the mutation effect as a result of direct action by ionizing radiations on the genetic apparatus of the cell.

76-000859 Prouse, N. J.; Gordon, D. C., Jr.; Keizer, P. D. EFFECTS OF LOW CONCENTRATIONS OF OIL ACCOMMODATED IN SEA WATER ON THE GROWTH OF UNIALGAL MARINE PHYTOPLANKTON CULTURES. J. Fish. Res. Board Can. 33 (4,1): 810-818. Apr. 1976. In English with French summ. SFA 21(2).

[Fish. Mar. Serv., Mar. Ecol. Lab., Bedford Inst. Oceanogr., Dartmouth, NS B2Y 4A2, Canada] Effects of three oils accommodated in sea water upon the growth of unialgal cultures of marine phytoplankton were investigated. The oil concentrations used covered the range normally encountered in sea water subjected to oil pollution (less than 1 mg/liter). In most experiments, minor stimulation or inhibition of growth was apparent but in only two experiments was the growth of oil-contaminated cultures statistically different from controls (in both instances stimulation). Extrapolation of the results to the natural environment is complicated by several factors, the most important of which appear to be variability in organism response and the observation that oil concentration and composition change during experiments. Oil concentrations encountered in polluted sea water can affect the growth of phytoplankton, but the effects seem to be minor and short-lived.

76-000860 Servizi, J. A.; Gordon, R. W.; Rogers, I. H.; Mahood, H. W. CHEMICAL CHARACTERISTICS AND ACUTE TOXICITY OF FOAM ON TWO AERATED LAGOONS. J. Fish. Res. Board Can. 33 (6): 1284-1290. June 1976. In English with French summ. SFA 21(2).

[Int. Pacific Salmon Fish. Comm., Sweltzer Creek Salmon Res. Lab., Cultus Lake, BC V0X 1H0, Canada] Foam collected from two aerated lagoons treating kraft pulp effluents was highly toxic to juvenile sockeye salmon (/Oncorhynchus nerka/). Chemical fractionation of one foam revealed large amounts of toxic resin acids and neutral diterpenes. In the other foam, toxicity was related to a pitch dispersant and unidentified material. Neither form was readily detoxified by biological treatment in the laboratory.

76-000861 Sliger, W. A. AN EVALUATION OF BICASSAY METHODS FOR DETERMINING ACUTE PHENOL TOXICITY TO CHANNEL CATFISH, /ICTALURUS PUNCTATUS/ (RAFINESQUE). Ph.D. dissertation, Okla. State Univ. 82p. 1975. From Diss. Abstr. Int. B Sci. Eng. 36(11), 1976. SFA 21(2).

Slow addition of phenol into tanks containing fingerling channel catfish increased the 48 hr TLm and LC(50) values by approximately 250 percent when compared with values obtained by immersion of fish into phenol. The slow introduction TLm's (mg/l) were: 48 hr, 67.01; 64 hr, 41.74; and 72 hr, 38.24. Although the TLm values decreased with increased exposure time, the 72 hr slow introduction TLm was still above the 48 hr TLm. Sudden immersion of fish into phenol solutions

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resulted in mortality during the initial hours of exposure, whereas the mortality resulting from slow addition of phenol was directly proportional to exposure time. The difference between the sudden immersion LC(50) of 31 mg/l and the slow introduction LC(50) of 82 mg/l measured the combined effects of handling stress, chemical shock, and possible acclimation to phenol. Surviving fathead minnows reproduced within 30 days following acute phenol exposures. No measurable differences in reproductive potential were found between exposed and unexposed fish. Significant increases in breathing rates of bluegill sunfish occurred within 6 hr following slow introduction to 10 mg/l and 20 mg/l phenol. Breathing rates of sunfish exposed to 1 mg/l and 5 mg/l phenol for 12 hr were not significantly different from the breathing rates of unexposed fish. Slow introduction, continuous flow bioassays provide a more meaningful measure of phenol toxicity because the method more closely simulates natural conditions. Changes in breathing rates of fish exposed to low concentrations of pollutants show considerable potential in determining subtle effects of pollutants on fish. --From abstr.

76-000862 Smith, E. J.; Sykora, J. L. EARLY DEVELOPMENTAL EFFECTS OF LIME-NEUTRALIZED IRON HYDROXIDE SUSPENSIONS ON BROOK TROUT AND COHO SALMON. Trans. Am. Fish. Soc. 105 (2): 308-312. Mar. 1976. SFA 21(2).
[U.S. Army Corps Eng., Federal Bldg., 1000 Liberty Ave., Pittsburg, PA 15222] A study of the effect of lime-neutralized iron hydroxide suspensions on eggs and alevins of brook trout (/Salvelinus fontinalis/) and coho salmon (/Oncorhynchus kisutch) was conducted with a modified proportional diluter. Effects were interpreted from data on hatchability, survival, and growth in five test concentrations and control. Growth of 90-day-old coho salmon alevins was reduced in water containing 1.27 mg Fe/liter of lime-neutralized suspended iron, whereas hatchability was unaffected in the highest concentration tested, 10.5 mg Fe/liter. However, 10.5 mg Fe/liter water had no measurable effect on hatchability, survival, and growth of brook trout alevins. The safe upper limit of lime-neutralized suspended iron for hatchability, survival, and growth of coho salmon alevins may lie between 0.97 and 1.27 mg Fe/liter.

76-000863 Stickney, R. R.; Windom, H. L. TISSUE RESPONSES IN ATLANTIC CROAKER, /MICROPOGON UNDULATUS/, EXPOSED TO LOW LEVELS OF CADMIUM. Presented at the 39th Annu. Meeting, Am. Soc. Limnol. Oceanogr., Savannah, Ga., June 21-24, 1976. 1976. SFA 21(2).
[Texas A&M Univ., College Station 77843] The addition of cadmium in a flow-through system at levels of 0.06 and 0.6 parts per billion (ppb) above backround did not generally result in an increased concentration of this metal in liver, muscle, stomach or gonadal tissue of the Atlantic croaker, /Micropogon undulatus/. With the exception of liver tissue, zinc levels declined with time during the course of the 14 week experiment. In general, reduction in tissue zinc concentrations occurred most rapidly in fish exposed to 0.6 ppb cadmium, followed by those exposed to 0.06 ppb cadmium and control fish, respectively. /M. undulatus/ appears to be able to accept slight increases in environmental cadmium concentration without responding physiologically by storing the metal in the tissues examined.

76-000864 Tompkins, J. A.; Tsai, C. SURVIVAL TIME AND LETHAL EXPOSURE TIME FOR THE BLACKNOSE DACE EXPOSED TO FREE CHLORINE AND CHLORAMINES. Trans. Am. Fish. Soc. 105 (2): 313-321. Mar. 1976. SFA 21(2).

[Cent. Environ. Estuarine Stud., Univ. Md., College Park 20742] Survival time and lethal exposure time were determined by continuous flow bioassay for blacknose dace, /Rhinichthys atratulus/, exposed to four concentrations each of free chlorine solutions and of chloramine solutions. For the concentrations tested, the lethal exposure time, a period of minimum exposure time of the fish in the test solutions to carry a toxic process to a point where recovery is no longer possible, was found to be shorter than the survival time, a period from the time of immersion to the time of death of the fish in the test solutions. The difference between median lethal exposure time and median survival time decreased with a decrease in total chlorine concentrations. Using either the median survival time or median lethal exposure time as the toxicity index, chloramines are more toxic than free chlorine to the blacknose dace at high concentrations, but less so in low concentrations.

76-000865 Warlen, S. M.; Wolfe, D. A. A LINEAR DDT FLUX MODEL FOR ATLANTIC MENHADEN. Presented at the 39th Annu. Meeting, Am. Soc. Limnol. Oceanogr., Savannah, Ga., June 21-24, 1976. 1976. SFA 21(2)

[NMFS, Atlantic Esturaine Fish. Cent., Beaufort, NC 28516] DDT flux in young-of-the-year menhaden (25 to 100 mm) can be simulated by a model in which assimilation rate = retention rate + turnover rate. Laboratory experiments using $^{14}$C-DDT provided values for assimilation rate which is the product of daily feeding rate, DDT concentration in the food, and the DDT assimilation fraction; for retention rate which is the fractional acumulation rate of DDT times the DDT concentration in menhaden; and for turnover rate which is the product of fractional turnover rate and DDT concentration in menhaden. The model may be used to estimate any one of its constant terms from the remaining values and from the variable function (the DDT concentration in menhaden) and serves as a basis of comparison of our experimental data with previous field observations. For example, the general compatibility in the model between the estimates of feeding rates and assimilation fractions and the DDT content of food (plankton-detritus) suggests that plankton-detritus actually was the source of DDT for wild menhaden.

76-000866 Zhirnova, A. A.; Kol'gayev, A. M.; Shirokova, N. N. THE EFFECT OF BASIC CUPROUS CARBONATE ON THE STATE OF THE LIVER IN JUVENILE AMUR AUTUMN CHUM (/ONCORHYNCHUS KETA/ INFRASP. /AUTUMNALIS/). J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (3): 453-456. 1974. SFA 21(2).

[TINRO, Amur, USSR]

## FISH TOXICANTS

76-000867 Rye, R. P., Jr.; King, E. L., Jr. ACUTE TOXIC EFFECTS OF TWO LAMPRICIDES TO TWENTY-ONE FRESHWATER INVERTEBRATES. Trans. Am. Fish. Soc. 105 (2): 322-326. Mar. 1976. SFA 21(2).

[U.S. FWS, Hammond Bay Biol. Stn., Millersburg, MI 49759] We conducted laboratory static bioassays to determine acute toxicity of two lampricides--a 70 percent 2-aminoethanol salt of 5,2'dichloro-4'-nitrosalicylanilide (Bayer 73) and a mixture containing 98 percent 3-

76-000867 CONTINUED
trifluoromethyl-4-nitrophenol (TFM) and 2 percent Bayer 73 (TFM-2B)--to 21 freshwater invertebrates. LC50 values were determined for 24-h exposure periods at 12.8 C. Organisms relatively sensitive to Bayer 73 were a turbellarian (/Dugesia tigrina/), aquatic earthworms (/Tubifex tubifex/ and /Lumbriculus inconstans/), snails (/Physa/ sp.) and (/Pleurocera/ sp.), a clam (/Eliptio dilatatus/), blackflies (/Simulium/ sp.), leeches (/Erpobdellidae/), and a daphnid (/Daphnia pulex/). The invertebrates most sensitive to TFM-2B were tubellarians, aquatic earthworms (/Tubifex/), snails (/Physa/), blackflies, leeches, and burrowing mayflies (/Hexagenia/ sp.). Bayer 73 was generally much more toxic to the test organisms than TFM-2B. At lampricidal concentrations, TFM-2B was more highly selective than Bayer 73 against larval sea lampreys (/Petromyzon marinus/).

76-000868 Schultz, D. P.; Harman, P. D. ANTIMYCIN: UPTAKE, DISTRIBUTION, AND ELIMINATION IN BROWN BULLHEADS (/ICTALURUS NEBULOSUS/). J. Fish. Res. Board Can. 33 (5): 1121-1129. May 1976. In English with French summ. SFA 21(2).
[U.S. FWS, Southeast. Fish Control Lab., Warm Springs, GA 31830] Radioactive antimycin was readily taken up in bile and tissues of brown bullheads (/Ictalurus nebulosus/) exposed to 0.045 ug/ml of $^{14}$C-antimycin for as long as 48 h. Bile contained the most and blood the least radioactivity at all sampling periods. The highest concentration of $^{14}$C-antimycin in muscle was 0.12 ug/g, after 21 h of exposure. The average amount of $^{14}$C-antimycin per fish was 0.94 ug/g. The $^{14}$C-antimycin concentration decreased with the elapse of time in the muscle and in samples of combined head, skin, and viscera. The concentration of $^{14}$C-antimycin in the exposure solution decreased from 0.045 ug/ml to 0.015 ug/ml after 12 h and 0.010 ug/ml after 48 h. The initial half-life of $^{14}$C-antimycin in the exposure solution was about 6.5 h. A second group of fish was exposed to 0.045 ug/ml of $^{14}$C-anyimycin for 48 h and then transferred to antimycin-free, flowing water for up to 96 h. The $^{14}$C-activity decreased in muscle tissue from 0.11 ug/g to 0.05 ug/g in 96 h. Half-life of $^{14}$C-antimycin was about 75 h in muscle and 61 h in the combined head, skin, and viscera.

## RESEARCH AND MANAGEMENT-GENERAL

76-000869 Duttweiler, M. W. USE OF QUESTIONNAIRE SURVEYS IN FORMING FISHERY MANAGEMENT POLICY. Trans. Am. Fish. Soc. 105 (2): 232-239. Mar. 1976. SFA 21(2).
[Dep. Nat. Resour., Cornell Univ., Ithaca, NY 14853] The desirability of incorporating fishermen preferences into management decision making was identified. A questionnaire survey technique based on a random sample of residents was developed tc obtain unbiased assessment of angler preference. The survey technique was tested in the Owasco Lake (New York) watershed.
A random sample of 1,092 Owasco Lake Basin residents was used to evaluate their preference for fishing and fishery management policies. The questionnaire was pre-tested for question effectiveness and clarity. A total of 794 completed forms were returned (73 percent). Effect of non-response was estimated through a phone survey of 60 nonrespondents. Twenty-nine percent of Owasco Lake Basin households contained Owasco Lake fishermen. Of those who fished at Owasco, 21 percent preferred lake trout, 17 percent preferred rainbow trout, 15 percent preferred walleye, and 47 percent other species. The most frequently cited reasons for fishing were: "for relaxation," "to get outdoors," and "for fun." The results represent an assessment of fishermen preference in the Owasco Lake locale and cannot be

76-000869 CONTINUED
generalized to other areas. However, the questicnnaire and sampling techniques that were developed can be used, with minor adaptations, in other recreational fisheries to obtain a systematic evaluation of preference that is far more reliable than casual contacts with sportsman organizations or individuals.

76-000870 Huang, C. C.; Vertinsky, I. B.; Wilimovsky, N. J. OPTIMAL CONTROLS FOR A SINGLE SPECIES FISHERY AND THE ECONOMIC VALUE OF RESEARCH. J. Fish. Res. Board Can. 33 (4,1): 793-809. Apr. 1976. In English with French summ. SFA 21(2).

[Inst. Anim. Res. Ecol., Univ. British Columbia, Vancouver, BC V6T 1W5, Canada] Mathematical proofs and analyses of solution methods are presented for determining optimal policies for the management of a single species fishery under equilibrium conditions. Previous intuitive arguments for solution of optimal policies controlling mesh size and fishing rate given complete information are explicitly proven. The analysis is extended to the case where some of the parameters describing the dynamics of the population are known only imprecisely to the manager. Using probability distributions for those unknown parameter values the problem is cast as a stochastic program where expected sustained net revenues from the fishery are maximized. The associated problem of optimal allocation of research resources under uncertainty conditions is considered by evaluating the direct value of such information to management activities.

Examples and algorithms are presented for the class of problems discussed.

76-000871 Massmann, W. H. 25 YEARS OF FEDERAL-STATE COOPERATION FOR IMPROVING SPORT FISHING. U.S. Fish Wildl. Ser. 37p. 1976. SFA 21(2)

[U.S. FWS, Washington, DC 20240] An outline of accomplishments under the Federal Aid in Fish Restoration (Dingell-Johnson) Program during its first 25 years, 1950-1975. --RS

76-000872 Penaz, M.; Lusk, S. THE PAST, PRESENT AND FUTURE OF CZECHOSLOVAK ICHTHYOLOGY. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (4): 461-466. 1974. SFA 21(2).

[Inst. Stud. Vertebr., Czech. Acad. Sci., Brno, Czechoslovakia]

76-000873 Reigier, H. A. SCIENCE FOR THE SCATTERED FISHERIES OF THE CANADIAN INTERIOR. J. Fish. Res. Board Can. 33 (5): 1213-1232. May 1976. In English with French summ. SFA 21(2).

[Inst. Environ. Stud., Univ. Toronto, Toronto, ON M5S 1A4, Canada] A healthy ferment exists in various fields of scientific research and management on Canadian freshwater fisheries. Important achievements have been registered in ecology, as well as in economics and on legal-jurisdictional aspects. The time is right to bring some order into recent administrative chaos to consolidate scientific contributions of the past, to encourage some recent initiatives, and to expedite research that is explicitly interdisciplinary, i.e. organized from transdisciplinary perspectives and conducted sc that the contributions of various disciplines are not readily discernible in the end products. A capability to transfer insights and information directly to planning and decision-making on large fisheries programs, on major industrial developments, and to regional governments and agencies is badly needed. Such a capability for freshwater fisheries can be stimulated into maturity by expanding and develcping some five or six interdisciplinary and interinstitutional scientific networks that have evolved in various parts of Canada in recent decades. These and other

76-000873 CONTINUED
specific conclusions are specified in some detail.

HABITAT ALTERATION

76-000874 Hastings, R. W.; Ogren, L. H.; Mabry, M. T. OBSERVATIONS ON THE FISH FAUNA ASSOCIATED WITH OFFSHORE PLATFORMS IN THE NORTHEASTERN GULF OF MEXICO. NOAA Fish. Bull. 74 (2): 387-402. Apr. 1976. SFA 21(2).

[Dep. Biol., Rutgers Univ., Camden, NJ 08102] The fish fauna associated with two U.S. Navy research platforms, Stage I and Stage II, in the northeastern Gulf of Mexico off Panama City, Fla., was studied at irregular intervals from 1970 to 1974. Such platforms function as artificial reef habitats and support diverse and abundant fish populations not normally characteristic of the open sandy bottoms in the area.

A total of 101 taxa (identified to family or species) was recorded at the two platforms; 61 species were observed at Stage I in water 32 m deep and 86 taxa at Stage II in water 18 m deep. The greater number of species recorded at the shallower location may be more a result of the greater number of observations made there than of differences in the two habitats. The number of species present at the platforms varies considerably at different times of the day and year. Species numbers are greatest during the summer and fall, but many species begin to move offshore or southward as the water temperature drops, and only about 50-60 percent of those recorded at the platform remain in December. The number of species diminishes to about 16 percent in February at Stage II, then increases gradually with the rising water temperature in the spring.

Major species occupying the platform habitats include fishes usually characteristic of pelagic, inshore (coastal or estuarine), and rocky reef environments. At the platforms, the pelagic species and most of the larger predators occupy various levels of the water column, either directly below or surrounding the structure, while most of the other species are associated either with the pilings and cross-members of the platform or with the bottom. For some of the species, the platform provides food and shelter, while for others, it offers only shelter. Some species may be present only to feed on the numerous fishes and other organisms concentrated there. Diel rhythms of activity are obvious for many of the fishes, with some species active only during the day, and others at night.

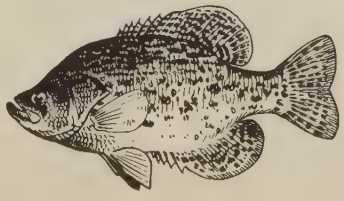
76-000875 Krizek, R. J.; Gallagher, B. J.; Karadi, G. M. WATER QUALITY EFFECTS OF DREDGING DISPOSAL AREA. Prcc. Am. Soc. Civ. Eng., J. Environ. Eng. Div. 102 (EE2): 389-409. Apr. 1976. SFA 21(2).

[Tech. Inst., Northwestern Univ., Evanston, IL] The effect of the settling-basin concept on the water quality associated with a typical disposal site for polluted maintenance dredgings, and the fate of pollutants during a typical dredging and disposal cycle were determined between Aug. 20, 1972 and Dec. 20, 1972 in Toledo, Ohio. Over 100 samples of slurry influent, overflow effluent, ground water, ambient river water, bottom sediments, and material from the hopper bins and overflow waters were collected and analyzed for standard physical, chemical, and microbiological parameters. It was concluded that only a small fraction of the pollutants are discharged via the overflow weir into the ambient river water; this is attributable to the fact that the polluting substances tend to associate with the solid particles, which settle out of the suspension and are retained within the diked enclosure. The water quality of the effluent resembled that of the ambient river water used as a carrier to pump

76-000875 CONTINUED
the dredgings in slurry form from the hopper dredge into the disposal area.

76-000876 Kuenzler, E. J. SEASONAL PATTERNS OF WATER QUALITY IN NATURAL AND CHANNELIZED SWAMP STREAMS OF EASTERN NORTH CAROLINA. Presented at the 39th Annu. Meeting, Am. Soc. Limnol. Oceanogr., Savannah, Ga., June 21-24, 1976. 1976. SFA 21(2).
[Univ. N.Car.,Chapel Hill] Aspects of water quality which might be affected by channelization were studied in six small streams in the Coastal Plain province of North Carolina. Three natural streams bordered by extensive seasonally flooded hardwood swamps were compared to three streams channelized to prevent flooding. Rainfall was well distributed throughout the year, but flooding of the natural swamps largely occurred in winter when evapotranspiration was low; the natural streams sometimes ceased flowing in summer. The summer periods of low flow were characterized by very low dissolved oxygen levels, but high levels of color and turbidity and high concentrations of ammonia, Kjeldahl-nitrogen, and particulate phosphorus in the natural streams. Channelized streams no longer flooded swamp forests, and base flow kept them flowing through the summer. Dissolved oxygen, nitrate, Kjeldahl-N, and particulate phosphorus concentrations were relatively high throughout the year in channelized streams.

76-000877 Pomeroy, W. M.; Stockner, J. G. EFFECTS OF ENVIRONMENTAL DISTURBANCE ON THE DISTRIBUTION AND PRIMARY PRODUCTION OF BENTHIC ALGAE ON A BRITISH COLUMBIA ESTUARY. J. Fish. Res. Board Can. 33 (5): 1175-1187. May 1976. In English with French summ. SFA 21(2).
[Dep. Biol., Univ. British Columbia, Vancouver, BC, Canada] Construction of a river training dyke at Squamish, B.C., has resulted in strong salinity, water transparency, and sedimentation gradients across the estuary face which have significantly affected the distribution and primary production of benthic algae. The estuary west of the dyke is now a very unstable habitat for algal colonization and growth. During river freshet, heavy sedimentation and salinities less than 3°/oo make algal survival difficult. At other times of the year, a salinity range of up to 25°/oo is common over a tidal cycle. Algae in this area are generally strongly euryhaline, the dominant species being /Enteromorpha minima/, /Rhizoclonium riparium/, and /Vaucheria dichomtoma/; mean production is 0.6 g C $m^{-2}$ $day^{-1}$. The eastern portion of the estuary has a more stable benthic environment; lower sedimentation and higher salinity result in greater species diversity, biomass, and primary production. Dominant species are /E. minima/, /Ulva lactuca/, /Pylaiella littoralis/, and a variety of diatom communities. These algae tend to be weakly euryhaline, with optimum salinities between 15 and 30°/oo. Mean production is 2.2 g C m 2 $day^{-1}$. Recent intrusion of /Fucus vesiculosus/ strongly indicates that the eastern estuary is developing into a more marine habitat.
Primary production of benthic algae is maintained by the wax and wane of low light and high light favoring species. Annual production estimates of 215 g C $m^{-2}$ approximate those for estuaries at similar latitudes.



MARKING AND TAGGING

76-000878 Fried, S. M.; McCleave, J. D.; Stred, K. A. BUOYANCY COMPENSATION BY ATLANTIC SALMON (/SALMO SALAR/) SMOLTS TAGGED INTERNALLY WITH DUMMY TELEMETRY TRANSMITTERS. J. Fish. Res. Board Can. 33 (6): 1377-1380. June 1976. In English with French summ. SFA 21(2).

[Dep. Zool., Univ. Maine, Orono 04473] Negative buoyancy was induced in Atlantic salmon (/Salmo salar/) smolts by insertion of dummy telemetry tags (4.0 g in water) into the stomach. Buoyancy adjustment by means of swimbladder volume change was determined in tagged and untagged (control) smolts either allowed or denied access to the water surface. Regression of percent recovery of initial buoyancy on recovery time showed that tagged fish with access to the surface gradually increased their buoyancy over a 6-h test period. Only 1 of 28 fish held 0.5-2.0 h recovered its initial buoyancy, while 7 of 26 held 2.5-4.0 h recovered, and 7 of 24 held 4.5-6.0 h recovered. Tagged fish without access to the surface never regained buoyancy and became slightly heavier with time. Two tagged fish without access to air were unable to compensate for negative buoyancy after 24 h, but exhibited total or partial recovery when examined 6 h after being allowed access. Control fish did not alter buoyancy with handling or over time.

76-000879 Hare, G. M.; Burt, M. D. B. PARASITES AS POTENTIAL BIOLOGICAL TAGS OF ATLANTIC SALMON (/SALMO SALAR/) SMOLTS IN THE MIRAMICHI RIVER SYSTEM, NEW BRUNSWICK. J. Fish. Res. Board Can. 33 (5): 1139-1143. May 1976. In English with French summ. SFA 21(2).

[Fish. Mar. Serv., Biol. Stn., St. Andrews, NB E0G 2X0, Canada] Ten parasite species (one protozoan, eight helminth, one mollusc) were collected from 1262 smolts of Atlantic salmon (/Salmo salar/) in the eight tributaries and estuary of the Miramichi River, New Brunswick, Canada during 1970 and 1971. Three of these parasites, /Discocotyle sagittata/, /Diplostomum spathaceum/, and /Neoechinorhynchus rutili/ showed restricted distributions within the study area. /Discocotyle sagittata/ infected 32.6 percent of 435 smolts collected from tributaries draining into the Main Northwest Miramichi River but only 0.3 percent of 604 smolts collected from tributaries draining into the Main Southwest Miramichi River. /Diplostomum spathaceum/ infected 18.9 percent of 148 smolts collected from the Southwest Miramichi River but was absent in 819 smolts collected from the remaining tributaries. /Neoechinorhynchus rutili/ infected 18.8 percent of 144 smolts collected from the Bartholomew River but only 0.2 percent of 895 smolts collected from the other tributaries. Presence of /Discocotyle sagittata/ on smolts collected in the estuary of the Miramichi River would identify smolts that originated in the Main Snorthwest Miramichi River, thus allowing for a separation of smolts from this branch and the other main branch, the Main Southwest Miramichi River. Presence of /Diplostomum spathaceum/ in smolts collected in the Main Southwest Miramichi River or in the estuary of the Miramichi River would identify smolts that originated in the Southwest Miramichi River. Presence of /N. rutili/ in smolts collected in the Main Southwest Miramichi River would identify smolts of Barthclomew River origin.

76-000880 Sebens, K. P. INDIVIDUAL MARKING OF SOFT-BODIED INTERTIDAL INVERTEBRATES IN SITU: A VITAL STAIN TECHNIQUE APPLIED TO THE SEA ANEMONE, /ANTHOPLEURA XANTHOGRAMMICA/. J. Fish. Res. Board Can. 33 (6): 1407-1410. June 1976. In English with French summ. SFA 21(2).

[Dep. Zool., Univ. Wash., Seattle 98195] The technique, employing a concentrated solution of neutral red dye, allows application of identifying marks in situ with minimal disturbance of the organism. Tests showed that the marks persisted for at least 12 mo.

The success of the method indicates its general utility for making soft-bodied invertebrates which have previously proved unsusceptible to long-term individual marking.

## STOCKING AND INTRODUCTIONS

76-000881 Carline, R. F.; Brynildson, O. M.; Johnson, M. C. GROWTH AND SURVIVAL OF TROUT STOCKED IN A NORTHERN WISCONSIN SPRING POND. Wis. Dep. Nat. Resour. Res. Rep. 85. 21p. Apr. 1976. SFA 21(2).

[Wis. Dep. Nat. Resour., Bur. Fish. Wildl. Manage., Box 450, Madison 53701] The purpose of this study was to determine growth and survival of June- and fall-stocked trout in Sportsman Lake, a 0.7-ha spring pond in Shawano County. Survival of fall-stocked trout to the following spring ranged from 48 to 77 percent and was directly related to the mean size of trout when released. All fall-stocked trout grew overwinter and their average weight ranged from 53 to 110 g in spring. Growth rates were inversely related to trout density. Changes in trout biomass from fall to the following spring varied from -25 to +35 percent. When the pond was stocked with more than 100 kg/ha of trout, the overwinter change in biomass was negative. Survival to spring of fingerling brook trout stocked in June 1972 and 1973 was 40 and 17 percent, respectively. Differences in growth rates were related to trout densities. Biomass of the 1972 stock increased from 20 kg/ha in June to 81 kg/ha the following April; the 1973 stock increased from 21 to 48 kg/ha over the same period. Costs of June stocks were about $137/ha and costs of fall stocks ranged from $265 to $392/ha when trout were valued at $3.30/kg. Based on overwinter changes in biomass of trout and relative costs of stocking, June fingerlings provided satisfactory populations in spring at the lowest cost. Detailed management recommendations include: (1) size of trout to stock in spring ponds, (2) stocking rates, (3) desirability of fish barriers and their design, (4) utilization of potential pond productivity through multi-species management, and (5) introduction of forage species for improved growth rates of trout. --From abstr.

76-000882 Karasev, G. L. RECONSTRUCTION OF THE FISH FAUNA IN TRANSBAIKALIA. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (2): 164-186. 1974. SFA 21(2).

[Baikal Dep., Sib. Fish. Res. Plan. Inst., Ulan-Ude, USSR] It is argued that there is a need to reconstruct the fish fauna in Transbaikalian waters (excluding the introduction of new species into the Baikal basin), which will permit a more intensive utilization of their productive potentialities. A complete summary of operations concerned with the introduction of fishes into Transbaikalia (1919-1972) is given for the first time. The results are summed and an indication is given of the lines of further research on the reconstruction of the Transbaikalian fish fauna. Emphasis is laid on the need for a conservative approach and for preservation of the indigenous fish fauna of the Baikal and Amur basins.

76-000883 Unkenholz, D. G. EVALUATION OF FISHERIES PROVIDED BY STOCKING YELLOW PERCH IN SELECTED MARGINAL LAKES, 1969-75. S.D. Dep. Game Fish Parks, Stud. Completion Rep., D-J Prcj. F-15-R-11, Stud. IV iv + 10p. Mar. 1976. SFA 21(2).

[S. Dak. Dep. Game Fish Parks, Pierre 57501] Stocking of yellow perch fingerlings was shown to be an effective method to provide winter fishing in lakes that may winterkill annually. Perch stocked as 2-3 inch fingerlings in the spring in a lake that had just winterkilled grow to an average length of 7.5 inches by October of the same year.

Stocking costs ranged from $0.40 to $6.34 per acre and the major cost component was time spent seining perch to be stocked. Survival of stocked perch was poor in lakes containing competitive fish species. Angler use on study lakes in which fishable populations of perch were established was sufficient to indicate that the perch had grown to a size attractive to anglers approximately 7 months after stocking.

Frequent winterkill in South Dakota lakes near population centers compounds the problem of meeting increased sport fishing demands in these areas. Approximately 18 months were required to produce harvestable-size fish with the stocking method used on winterkill lakes prior to this study.

Management of the type demonstrated in this study is recommended for marginal lakes because of the short time required to produce desirable-size perch at a reasonable cost.

## FISHING GEAR AND TECHNIQUES

76-000884 May, N.; Trent, L.; Pristas, P. J. RELATION OF FISH CATCHES IN GILL NETS TO FRONTAL PERIODS. NOAA Fish. Bull. 74 (2): 449-453. Apr. 1976. SFA 21(2).

[NMFS, Gulf Coastal Fish. Cent., Panama City, FL 32401] The results suggest that many species of marine fishes become more vulnerable to capture by gill nets in shallow areas of coastal bays during frontal periods in autumn. This increased vulnerability probably results from increased activity, migration, a lessening ability to avoid the net, and one or more of the factors associated with fronts, e.g., changes in temperature, tidal height, turbidity, and current velocity. --From concl.

76-000885 Westrheim, S. J. A FURTHER NOTE ON SAMPLING RESEARCH TRAWL CATCHES AT SEA. J. Fish. Res. Board Can. 33 (5): 1196. May 1976. In English with French summ. SFA 21(2).

[Fish. Mar. Serv., Pacific Biol. Stn., Nanaimo, BC, V9R 5K6, Canada] An additional 108 empirical tests (19 species) have corroborated the validity of a method, described in 1967, for estimating total weight of individual species in trawl catches. Mean error was -0.6 percent, and in 97 percent of the tests, error was no more than ± 4 percent.

## MATHEMATICS, STATISTICAL METHODS AND MODELING

76-000886 Hughes, S. E. SYSTEM FOR SAMPLING LARGE TRAWL CATCHES OF RESEARCH VESSELS. J. Fish. Res. Board Can. 33 (4,1): 833-839. Apr. 1976. In English with French summ. SFA 21(2).

[NMFS, Northeast Fish. Cent., Seattle, WA 98112] Procedures and sampling gear designed 1) to sample large research trawl catches prior to sorting by species and 2) to reduce catch handling time and permit an increase in the number of hauls per cruise, are discussed and illustrated. The rationale behind the method relies on the hypothesis that species and size stratification in the codend of the trawl are bilaterally symmetrical. The codend is positioned above a deck bin prior to releasing the catch so that a sampling net can be lifted from the deck bin to remove about one half of the total catch. The sampled portion is processed on a fish sorting table, and the unused portion brailed overboard by a net which lines the entire deck bin. Tests conducted in Puget Sound indicated that the species composition and length distribution in the sample adequately represented the total catch; errors greater than 25 percent were usually restricted to species composing less than 5 percent of the catch, and for dominant species errors were less than 10 percent.

76-000887 Zhakov, L. A.; Menshutkin, V. V. A MATHEMATICAL MODEL OF A LAKE ICHTHYOCOENOSIS. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (3): 335-342. 1974. SFA 21(2).

[USSR Acad. Sci., Lenningrad, USSR] A mathematical model of a lake ichthyocoenosis programmed for computer has been produced. Allowance is made in the model for the trophic links of fish populations and for the effect of abiotic factors. The model is used to investigate the structure and dynamics of ichthyocoenoses in relation to the feeding and chemical hydrologic characteristics of lakes in Vologda Province. The proposed model may be used in the solution of problems connected with the exploitation or reconstruction of the fish fauna of lakes or reservoirs.

## LAKE MANAGEMENT & RESEARCH

76-000888 Bull, C. J.; Mackay, W. C. NITROGEN AND PHOSPHORUS REMOVAL FROM LAKES BY FISH HARVEST. J. Fish. Res. Board Can. 33 (6): 1374-1376. June 1976. In English with French summ. SFA 21(2).

[Dep. Recreation Conserv., Fish Wildl. Br., Penticton, BC, Canada] Phosphorus (P) made up 0.3-0.5 percent of the wet weight of four species of fish. Nitrogen (N) accounted for a further 2.4-2.9 percent. If the maximum annual yield of fish was harvested from the lakes studied, less than 1 percent of the phosphorus and nitrogen entering the lake would be removed. On the basis of our data fish harvest would apparently not significantly slow nor reverse the process of eutrophication.

76-000889 DeRoche, S. E. THE SEBAGO LAKE STUDY. Me. Dep. Inland Fish. Wildl. Fish. Res. Bull. No. 9. 56p. 1976. SFA 21(2).

[Maine Dep. Inland Fish. Wildl., 284 State St., Augusta 04330] The following recommendations are based on knowledge gained from this study and unsolved problems that still exist in Sebago Lake:

1. Under no circumstance should DDT and/or other "hard" pesticides be used in the Sebago Lake drainage.

2. Pesticide assays of Sebago Lake salmon should be made every 5 years as a continuation of the monitoring program to detect increases or decrease of DDT or other pesticides.

3. The trapping of mature salmon should continue on the Jordan River spawning migrations to monitor age and growth status and the general health and well-being of the Sebago Lake salmon population.

4. Partial creel censuses and volunteer fishing records should be continued to evaluate changes in fishing success and fishing quality resulting from current and future fishery management programs.

5. A continuation of production studies in the Northwest River, Crooked River, and Mile Brook is necessary. These studies should be conducted on an alternate year basis to determine the progress made toward reaching full salmon production in these streams.

6. Because of the high intensity of fishing pressure at Sebago Lake, changes in fishing regulations seem necessary. As soon as the present salmon growth problems are solved, a length limit and a bag limit should be established which will assure the maintenance of a healthy salmon population. It appears that the 16-inch, 3-fish bag limit might be appropriate to accomplish this objective.

7. The Bolster's Mill fishway trap on the Crooked River should be operated long enough to determine when and if the spawning runs of salmon in the Crooked River have reached maximum proportions.

8. Lake trout stocking in Sebago should be discontinued, at least temporarily, pending restoration of normal smelt abundance.

9. Continued monitoring of the fish populations in Sebago Lake is necessary to provide the necessary information required for the management of the lake's fishery resources. --From recommendations

76-000890 James, G. J. EFFECTS OF HUMAN ACTIVITIES ON MOUTAIN LAKES IN CALIFORNIA. Ph.D. dissertation, Univ. Calif. (Irvine) 97p. 1975. From Diss. Abstr. Int. B Sci. Eng. 36(10), 1976. SFA 21(2).

To demonstrate the magnitude of human impact on mountain lakes in California, four lakes which had varying degrees of human utilization were selected for study. These included: Big Bear Lake and Lake Arrowhead in the San Bernardino Mountains, and Heather Lake and Tamarack Lake in the Sierra Nevada Mountains. Big Bear Lake had the highest degree of human utilization followed by Lake Arrowhead, Heather Lake, and Tamarack Lake. The study was divided into three parts. The consideration of physical lake features included depth recordings, temperature, dissolved oxygen, and water clarity determinations. Chemical properties of the lake waters studied included analyses for the plant nutrients NO(3)-N, total-N, ortho-P, and total-P. A spectrographic scan, as well as pH determinations and coliform bacteria counts were conducted. Batch algal assay culture experiments were carried out on the lake waters. All of the parameters studied showed variations from lake to lake as well as on a seasonal basis. Big Bear Lake with a long history of nutrient addition and ready access to human visitation had the poorest water quality based on the various parameters used. Lake Arrowhead proved to be less degraded than Big Bear Lake. Heather Lake and Tamarack Lake were found to be oligotrophic although differences in water quality were detected. Heather Lake had higher plant nutrient and coliform bacteria concentrations. Water quality in both Heather Lake and Tamarack Lake was considerably better than that in Big Bear Lake or Lake Arrowhead based on the parameters used. The reasons for the observed differences

76-000890 CONTINUED
were thought to be due to the differing amount of use each lake receives from its human visitors.

76-000891 Jensen, A. L. ASSESSMENT OF THE UNITED STATES LAKE WHITEFISH (/COREGONUS CLUPEAFORMIS/) FISHERIES OF LAKE SUPERIOR, LAKE MICHIGAN, AND LAKE HURON. J. Fish. Res. Board Can. 33 (4,1): 747-759. Apr. 1976. In English wtih French summ. SFA 21(2).
[Sch. Nat. Resour., Univ. Mich., Ann Arbor 48104] The logistic surplus production model is applied to lake whitefish (/Coregonus clupeaformis/) yield and effort data from Lake Superior, Lake Michigan, and Lake Huron. The fitted models indicate that the whitefish populations in most areas of the lakes have been overexploited, and that in these areas yield was below the maximum sustainable yield before sea lamprey (/Petromyzon marinus/) predation took its toll. In some areas of Lake Superior the whitefish populations are not overexploited. The sea lamprey is the apparent cause of the drastic decrease in the whitefish population that occurred in northern Lake Michigan during the 1950's.

76-000892 Myers, G. L.; Peterka, J. J. SURVIVAL AND GROWTH OF RAINBOW TROUT (/SALMO GAIRDNERI/) IN FOUR PRAIRIE LAKES, NORTH DAKOTA. J. Fish. Res. Board Can. 33 (5): 1192-1195. May 1976. In English with French summ. SFA 21(2).
[Dep. Zool., N. Dak. State Univ., Fargo 58102] Survival of rainbow trout (/Salmo gairdneri/) in three North Dakota prairie lakes was low the 1st mo after stocking, ranging from 15 to 54 percent; high mortality may have been due to bird predation. In a forth lake, where 77 percent survived the 1st mo, no predatory birds were observed. All fish in two lakes died in August when dissolved oxygen levels dropped to below 1.0 mg/liter following July blue-green algae blooms of 28 and 63 $mm^3$/liter. In the other two lakes harvests in October ranged from 0.1 to 4.4 percent of fish stocked. Mean wet weights at harvest of up to 272 g were sufficient for commercial use; however, special management to improve survival rates would be necessary in the lakes studied.

76-000893 Smith, S. A.; Knauer, D. R.; Wirth, T. L. AERATION AS A LAKE MANAGEMENT TECHNIQUE. Wis. Dep. Nat. Resour., Tech. Bull. No. 87. 41p. 1975. SFA 21(2).
[Wis. Dep. Nat. Resour., Box 450, Madison 53701] In order to successfully evaluate hypolimnetic aeration, aerators were installed in two eutrophic lakes in central Wisconsin. The major component of the hypolimnetic aerator consisted of a 40-ft long, 18-inch diameter polyethylene tube with an internal longitudinal plate dividing the tube in half and twisted to form a helix. Compressed air or a combination of compressed air and liquid oxygen were supplied to the base of the unit and water was air lifted up the tube to enter a 4-ft by 4-ft by 8-ft bubble separation box at the surface of the lake, where the air bubbles were vented to the atmosphere. The bubble-free oxygenated water was returned to the hypolimnion via two 18-inch diameter flexible return tubes. An evaluation of the unit was completed in a eutrophic, clear, hard water lake (Mirror) in 1972 and 1973 and in a dystrophic soft water lake (Larson) in 1973. The initial studies indicated that all of the oxygen transfer from the compressor occurred in the bottom half of the unit, with further transfer occuring in the surface separation box as the water momentarily came in contact with the atmosphere.
Under operating conditions at Mirror Lake with an air supply of 16 cfm and a water flow moving through the aerator at 4.2 cfs, the dissolved oxygen transfer efficiency of the entire unit (including

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oxygen transfer in the separation box) was 20 percent. A combination of compressed air at 16 cfm and liquid oxygen at 5.5 cfm was supplied to the aerator giving a water flow of 5.3 cfs and an oxygen transfer efficiency of 23 percent. The oxygen transfer efficiency at Larson Lake with compressed air only was between 12 and 14 percent.

Both Mirror and Larson lakes had anoxic hypolimnia during the summer months. Attempts at satisfying the very high oxygen demands in Mirror Lake (maximum biological oxygen demand in the bottom water was 39 mg/l before aeration) were unsuccessful during limited aeration in 1972 and extended operation in 1973. However, the operation of the aerator in Larson Lake proved successful. Dissolved oxygen concentrations in the hypolimnion increased from 0.0 to 7.0 mg/l. At present, establishment of a cold water fishery appears possible in Larson Lake and current research has indicated a trout population can be maintained in the hypolimnion.

## RIVER AND STREAM MANAGEMENT & RESEARCH

76-000894 Burns, D. C. THE IMPORTANCE OF THREE HABITAT TYPES TO RAINBOW TROUT (/SALMO GAIRDNERI/) IN SAND SPRINGS CREEK, IDAHO. Ph.D. dissertation, Univ. Idaho 67p. 1975. From Diss. Abstr. Int. B Sci. Eng. 36(10), 1976. SFA 21(2).

Sand Springs Creek, a spring fed stream about 1.8 km long, discharged approximately 2.8 $m^3$/sec at 14 to 17C throughout the year. The creek was divided into three habitat types. Habitat one (11690 $m^2$) had a mean depth of 0.35 m, and mean surface and bottom current velocities of 0.97 and 0.21 m/sec, respectively. This habitat had many macrophytes and a diverse benthic fauna. Habitat two (25290 $m^2$) had a mean depth of 0.78 m and mean surface and bottom current velocities of 0.34 and 0.20 m/sec, respectively. It was a silty habitat with few macrophytes and a nondiverse benthic fauna. Habitat three (36750 $m^2$) had a mean depth of 2.14 m and mean surface and bottom current velocities of 0.37 and 0.32 m/sec, respectively. It had abundant macrophytes and a moderately diverse benthic fauna. Rainbow trout (/Salmo gairdneri/) captured in a habitat by hook and line appeared to feed on organisms from that habitat. /Cottus greenei/, /Hyalella azteca/, and chironomids were major diet items. Regression analysis of snorkeling counts showed that habitat one accounted for 0.139 rainbow trout per $m^2$, habitat two accounted for 0.047 trout per $m^2$, and habitat three accoutned for 0.073 trout per m Food production in habitat one could not account for the high trout density associated with it; however, food production in the stream could account for the food utilized by trout. Submerged cover probably limited trout abundance. Peterson estimates on a stream section showed trout production to be 16.0 g/$m^2$/yr. By extrapolation to the whole stream on the basis of trout density accounted for by a habitat, production of rainbow trout was estimated at 15.2 g/$m^2$/yr. The results indicated that useful conclusions may be drawn by typing habitats in streams.

76-000895 Troitskiy, S. K. THE FISH FAUNA AND COMMERCIAL IMPORTANCE OF THE LOWER REACHES OF THE NORTHERN DONETS. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (3): 359-366. 1974. SFA 21(2).

[Az NIIRKh, Rostov-on-Don, USSR] On the basis of an investigation of the Northern Donets from the mouth to the town of Donetsk a fish fauna consisting of 43 species is noted. A connection is established between the fish fauna of the rivers of the Caucasus and the Donets Ridge. The main commercial importance of the Northern Donets is shown to be the reproduction of the vimba. The measures needed to increase the abundance of this species and of other food fishes are listed. In

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order to increase the fisheries importance of the lower reaches of the Northern Donets it is essential to reduce pollution, to provide access to the spawning grounds and to protect vimba spawners.

FARM POND AND SMALL IMPOUNDMENT MANAGEMENT

76-000896 Barwick, D. H.; Holcomb, D. E. RELATION OF LARGEMOUTH BASS REPRODUCTION TO CROWDED SUNFISH POPULATIONS IN FLORIDA PONDS. Trans. Am. Fish. Soc. 105 (2): 244-246. Mar. 1976. SFA 21(2).

[U.S. FWS, Southeast Reservoir Invest., 206 Hwy. 123, Clemson, SC 29631] Largemouth bass (/Micropterus salmoides/) were studied in an effort to determine if a repressive factor or predation by sunfishes (/Lepomis/ sp.), or both, caused failure of bass reproduction in ponds crowded with sunfishes. In addition, we observed anosmic bass to determine if lack of olfaction would allow bass to spawn, in the event that a repressive factor operating through the sense of smell was the inhibitor. However, neither a repressive factor nor sunfish predation was believed to be responsible for lack of reproduction. Lack of reproduction was apparently associated with a physical factor that in some way interrupted normal bass breeding activity.

76-000897 Baur, R. J.; Buck, D. H.; Rose, C. B. THREE YEARS OF EXPERIENCE WITH A CHANNEL CATFISH CATCHOUT POND IN ILLINOIS. Trans. Am. Fish. Soc. 105 (2): 247-253. Mar. 1976. SFA 21(2).

[Ill. Nat. Hist. Surv., Kinmundy, IL 62854] A 0.2-hectare channel catfish, /Ictalurus punctatus/, catchout pond was operated for three fishing seasons to develop techniques beneficial to both angler and pond owner. During the first two seasons catfish were cage-reared to catchable size in the catchout pond and periodically released to replace fish caught by anglers. The larger and/or faster-growing catfish were more vulnerable to capture by hook-and-line angling than the smaller and/or slower growing individuals.

During the second season cage-reared fish were released more frequently, while "hard-to-catch" fish were trapped or seined from the pond and caged for a week before returning them to the pond. Caging the fish for a short time did not improve catchability, but fish reared in cages were highly vulnerable to angling when released.

During the third year largemouth bass, /Micropterus salmoides/, were stocked along with the catfish, and both species were maintained on a pellet diet. In 65 fishing days anglers harvested 90 percent of the catfish and 83 percent of the bass. The high catch rate was attributed to fluctuations in the amount of pellets offered and interspecies competition for the available food. Angler interest was more constantly maintained because the bass would bite during those periods when the catfish would not.

Applying theoretical cost accounting, net income per hectare ranged from $713.45 to $3,892.35.

76-000898 Duever, M. J. BOTTOM AND SURFACE DISCHARGE REGIME EFFECTS IN A SMALL RESERVOIR. Presented at the 39th Annu. Meeting, Am. Soc. Limnol. Oceanogr., Savannah, Ga., June 21-24, 1976. 1976. SFA 21(2)

[Natl. Audubon Soc., Corkscrew Swamp Sanctuary, Naples, FL] The discharge from a 42 hectare reservoir in north Georgia was released through a bottom outlet for 2 years, then over a spillway for 2 years. Under surface discharge there was intense stratification of dissolved oxygen and temperature, whereas bottom discharge produced a weak decline with depth for these parameters. Turbidity was higher during

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surface discharge, due to streamflow moving through the lake in the upper portion of the thermocline. Regardless of discharge regime, winter pH values were approximately 6.6 to 6.9 at all depths, and summer values were 6.3 to 6.5 at the bottom and 7.0 to 7.5 in the upper waters. Total dissolved solids were 30 ± 5 ppm and hardness and alkalinity 5 to 10 ppm at all depths, seasons, and discharge regimes. Under the two types of discharge, dissolved oxygen and temperature in the reservoir's top 4m were similar, and the rooted vegetation, confined primarily to this zone, did not differ in biomass or composition. However, during epilimnial discharge aufwuchs biomass was reduced at all depths (1, 3, 5, 7, 9m) sampled. Zooplankton populations were greater during epilimnial discharge. No discharge-regime-related differences in benthic populations were detected.

76-000899 Georgia Dep. Nat. Resour., Game & Fish Div. MANAGEMENT OF GEORGIA FISH PONDS. Ga. Dep. Nat. Resour., Game Fish. Div. 24p. 1976. SFA 21(2).
[207 Washington St., S.W., Atlanta 30334] A popularly written handbook discussing pond construction, stocking, fertilization, and harvests. --RS

## LARGE IMPOUNDMENT MANAGEMENT & RESEARCH

76-000900 Tsyplakov, E. P. EXPANSION OF THE RANGES OF SOME FISHES IN CONNECTION WITH HYDRAULIC ENGINEERING WORKS ON THE VOLGA AND ACCLIMATIZATION OPERATIONS. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (3): 343-351. 1974. SFA 21(2).
[Tatar Dep., State Res. Inst. Lake River Fish., USSR] It has been established that the fish fauna of Kuybyshev reservoir has been supplemented by the penetration of northern and southern forms. Some of them (Baltic lake smelt, Lake Beloye cisco, eel, "tyulka") have penetrated naturally, others (pelyad) have been introduced, yet others ("black-striped pipefish," "round goby," "starry pugolovka") have been brought in accidently from the Don estuary and Tsimlyansk reservoir along with introduced forage organisms.

76-000901 Vovk, P. S. THE POSSIBILITY OF USING THE BIGHEAD CARP [/HYPOPHTHALMICHTHYS MOLITRIX/] TO INCREASE THE FISH PRODUCTION OF THE DNIEPER RESERVOIRS AND TO DECREASE EUTROPHICATION. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (3): 351-358. 1974. SFA 21(2).
[Inst. Hydrobiol., Ukranian Acad. Sci., Kiev, USSR] An account is given on the part played by blue-green algae in the feeding of the bighead carp and their importance in the nutrition of other species of fishes. Consideration is given to the possible effect on the bighead carp of toxic substances given off by blue-green algae. It is concluded that it is desirable to stock the Dnieper reservoirs with bighead carp for fattening with the object of increasing fish output and decreasing the level of eutrophication of these reservoirs by the use of a considerable part of the seston.

ESTUARY MANAGEMENT & RESEARCH

76-000902 Livingston, R. J.; Kobylinski, G. J.; Lewis, F. G. III; Sheridan, P. F. LONG-TERM FLUCTUATIONS OF EPIBENTHIC FISH AND INVERTEBRATE POPULATIONS IN APALACHICOLA BAY, FLORIDA. NOAA Fish. Bull. 74 (2): 311-321. Apr. 1976. SFA 21(2).

[Dep. Biol. Sci., Fla. State Univ., Tallahassee 32306] A 3-yr study was made concerning seasonal changes in the biota of Apalachicola Bay. The Apalachicola River causes a temporal progression of changes of various environmental parameters in the bay such as salinity, turbidity, nutrients, and detritus levels. Fishes were more widespread in their distribution throughout the bay than invertebrates. This was thought to be related to trophic response and habitat preference. High levels of relative dominance prevailed for both groups with the top three species of each group accounting for more than 80 percent of the total number of individuals taken.

Peak levels of monthly abundance of various dominant fish species tended not to overlap through a given 12-mo period. Invertebrate species abundance usually reached peak levels during summer and fall periods. The seasonal appearance and distribution of organisms in the Apalachicola Bay system was comparable to that found in other estuaries in the northern Gulf of Mexico. The temporal and spatial distribution of estuarine fishes and invertebrates was associated with species-specific reproductive cycles, trophic relationships, and habitat preferences. The Apalachicola estuary was viewed as a seasonally stable system, with regular temporal fluctuations of the biota through each annual cycle.

MARINE MANAGEMENT & RESEARCH

76-000903 Novoa, D.; Ramos, F. LA PESQUERIA DE ATUN POR PELANGRE EN VENEZUELA DURANTE EL PERIODO 1960-1972. [THE TUNA FISHERY IN VENEZUELA 1960-1972.] Venez. Minist. Agric. Cria Inf. Tech. no. 64: [29p.] 1976. In Spanish with English summ. SFA 21(2).

[Minist. Agric. Cria, Of. Nac. Pesca, Caracas, Venezuela] This report offers a brief description of the local tuna fishery, in which the customary operating area of the Venezuelan long liners is delimited and some characteristics of the fleet and the composition by species of the catches are given. An analysis is also made of the evolution of the fishing effort, the landings and the catch by unit of effort during the period 1960-1972, with data compiled through the reports of fishing boat masters and processing plant records. A preliminary analysis of the changes in the catch rates (c/f) in said preiod shows a continued decrease of the relative abundance of the resource. It is worth noting that at the present time the fishermen engaged in the activity are getting catches similar to those reported at the beginning of this fishery, but these results are being made possible by doubling the fishing effort. It is the author's belief that this fishery is being excessively exploited, and that the stocks of yellowfin tuna are rapidly decreasing and nearing the point of maximum catch permissable. The probabilities are that by increasing the fishing effort no equivalent gains in the catch rates will be achieved. Biological data is also given concerning the composition by sizes, by sex and by species, of the commercial landings, in addition to remarks on the stomach contents of the yellowfin tuna (/Thynnus albacares/). --Summ.

76-000904 Rikhter, V. A. A STUDY OF THE DYNAMICS OF RED HAKE (/UROPHYCIS CHUSS/) CATCHES FROM THE NORTHWEST ATLANTIC BY THE METHOD OF SIMULATION. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (4): 484-491. 1974. SFA 21(2).

[AtlantNIRO, Kaliningrad, USSR] The possibility of two kinds of fishery is established. Eumetric conditions arise if there is fishing in the shallows of the shelf when the entire commercial stock from yearlings onward is concentrated there. The optimum mesh size is 5.4 cm. The winter fishing on the slopes of the shelf is for larger fish, which makes it possible to increase mesh size to 7.4 cm. With this type of fishery the catch is reduced by approximately 20 percent relative to the maximum possible catch. When the fishing rate is abruptly increased (recruitment constant) stabilization of catches occurs in the 4th year. By this time, when the fishing mortality coefficient (F) is increased from 0.1 to 0.7, the catch is reduced by approximately 30 percent of the level of the first year. The level of possible catches is understated if the natural mortality coefficient (M) is assumed to be constant in modelling.

76-000905 Silfontes, F. R. RECOMENDACIONES PARA EL DESARROLLO DE LAS PESQUERIAS DE ATUN EN VENEZUELA. [RECOMMENDATIONS FOR THE DEVELOPMENTS OF THE TUNA FISHERY IN VENEZUELA.] Venez. Minist. Agric. Cria Inf. Tech. no. 65: [6p.] 1976. In Spanish with English summ. SFA 21(2).

[Minist. Agric. Cria, Of. Nac. Perca, Caracas, Venezuela] This report offers a brief analysis of the present status of the tuna fishery in Venezuela and the causes of the almost total disappearance of the Venezuelan longline fleet. Reference is also made to the growing volume of the imports of foreign frozen tuna to meet the requirements of the domestic canning industry, particularly in the year 1974. Mention is also made of the performance in Venezuela, during a 15 month period, of Japanese fleet of bait-ships engaged in the tuna fishery. And lastly the author includes some recommendations which he believes ought to be taken into account in attempting to deal with the crisis confronted. --summ.

## MISC. TECHNIQUES AND EQUIPMENT

76-000906 Hewitt, R. P.; Smith, P. E.; Brown, J. C. DEVELOPMENT AND USE OF SONAR MAPPING FOR PELAGIC STOCK ASSESSMENT IN THE CALIFORNIA CURRENT AREA. NOAA Fish. Bull. 74 (2): 281-300. Apr. 1976. SFA 21(2).

[NMFS, Southwest Fish. Cent., La Jolla, CA 92038] Samples of the two major acoustic properties of fish schools are presented, i.e., acoustically derived horizontal dimensions (representative of school volume) and target strengths (which may be representative of school compaction). Sampling biases and sources of sampling variability in the measurement of these properties are discussed. The results of two experiments, conducted to determine the weight of a fish school as a function of its acoustic characteristics, are presented. In the first experiment, an acoustically transparent trap was used to recreate an aggregation of fish and in the second, commercial fishing boats were chartered to capture whole schools. An automated sonar data acquisition and processing system is described and test results presented. The results of paired automated surveys of the Los Angeles (southern California) Bight are presented and discussed. The paper reports development of the sonar-fish school mapping method first documented by P.E. Smith in 1970. Field investigation, conducted in cooperation with the Navy and the California Department of Fish and

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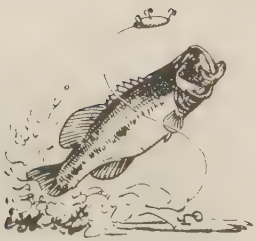
Game, indicate a median school size of 30 m diameter, a mean fish density of 15 kg of fish biomass per square meter of horizontal school area, and a biomass estimate of 1.23 to 2.30 X $10^6$ metric tons for pelagic schooled targets in the Los Angeles Bight. --From abstr.

76-000907 Kanep, S. V. IMPROVEMENTS IN ICHTHYOLOGICAL RESEARCH METHODS. J. Ichthyol. (Engl. Transl. Vopr. Ikhtiol.) 14 (4): 599-603. 1974. SFA 21(2).
[GosNIORKh, Lenningrad, USSR] Discusses "Coefficient of Fleshiness," the relative proportion of the food product, relative dimensions of linear characters, correlatograms, and determination of fin area. -- RS

76-000908 Stira, R. J.; Reed, R. J.; Middleman, S. A METHOD FOR MAKING ARTIFICIAL FISH EGGS. Trans. Am. Fish. Soc. 105 (2): 349-350. Mar. 1976. SFA 21(2).
[Mass. Coop. Fish. Res. Unit, Univ. Mass., Amherst 01002] A method of making artificial fish eggs ("geleggs") is described. Dyed gelatin droplets drip into cold organic solvent where they solidify as spheres; the spheres are then treated with a cross-linking compound. The result is a durable and easily stored imitation of pelagic or semi-pelagic fish eggs for use in egg drift and distribution studies.



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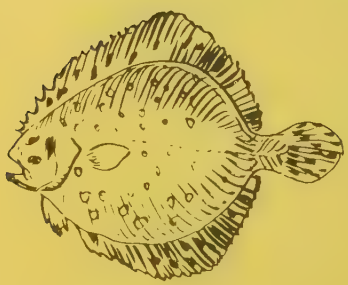

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